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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking into Policies to Promote a Partnership Framework between Energy Investor Owned Utilities and the Water Sector to Promote Water-Energy Nexus Programs.	Rulemaking 13-12-011 (Filed December 19, 2013)

ASSIGNED COMMISSIONER'S RULING ENTERING WORKSHOP REPORT INTO THE RECORD AND SEEKING COMMENT

Summary

In today's ruling, I am entering an eighth and final workshop report into the record in the Water Energy Telecommunications Nexus track of this proceeding. I invite parties to comment on the report and the themes arising from the proceeding more broadly.

1. Proceeding Scope

On April 27, 2015, I issued an Amended Scoping Memo in this proceeding incorporating actions related to the water-energy nexus to address Governor Brown's Executive Order B-29-15 relating to the drought emergency (Section 2.1 issue 3 of the Amended Scoping Memo), actions to address the water-energy nexus in water conveyance, delivery, and use for water storage… water recharge … water delivery, and other areas including enabling demand response and time shifting (Section 2.1 issue 4, bullet 1 of the Amended Scoping Memo), actions to address the water-energy nexus in energy production, transmission, distribution, and use, design, deployment, and utilization of onsite micro grids, construction and design of energy generation, storage and management facilities, implementation of demand response, ancillary services, grid services, advanced grid services; and interconnection issues, ownership issues for maximum effectiveness; in agricultural pumping and irrigation, in residential and commercial landscaping; in current and potential for water recycling efforts and programs; and in maximizing local water sources (Section 2.1, issue 4, bullet 2 of the Amended Scoping Memo).

Water and energy utility coordination on energy smart meter piggybacking pilots and the water/energy nexus cost calculator are only the first of many steps in fully considering the water/energy nexus. We also need to ensure that adequate telecommunications infrastructure is accessible to enable proper management of water and energy resources, facilities and systems. Reliable and affordable telecommunications is necessary for distributed energy resources (DERs) and energy facilities in electric systems, all water pumping, treatment, processing, recycling, and desalination operations, and to management of water leaks, distribution, operations, and consumption in water and electric systems. Each of these facilities is energy intensive and produces operations data that must be known and managed. This management, if optimized, could benefit both the water and energy ratepayer through safer and more reliable service, lower overall costs, and enhanced stewardship of our natural resources. This information exchange can happen over a variety of telecommunications technologies.

The eighth workshop in the Water Energy Telecommunications portion of the proceeding highlighted the large technical and access gaps to enable data from Distributed Energy Resources (DERs) and water resources to travel to the utility or operators for either visibility or control. Today DERs have limited, and in many cases no grid visibility and control capability. Changing that paradigm so that DERs are visible and controllable, and capable of being compensated in a market-based clean energy mechanism, requires making telecommunications facilities and services that comply with grid management standards available for DER visibility and control. Grid services and market participation at the distribution level will languish until this large technical and access gap is addressed and closed.1

Our goal is to ensure that energy and water utilities, other investor owned utilities, and respondent telecommunications carriers take the necessary actions to promote water management and conservation, energy management and conservation, through access to communications facilities and services. Infrastructure and services to provide both voice and internet communications including narrowband and broadband signals are critical to water and energy management, resources use, and public safety. By breaking down silos, we promote utility collaboration to solve big problems through coordinated effort.[2]

The Water-Energy-Communications Nexus track of this proceeding examines the nexus of water, energy, and communications (*e.g.,* the use of information management and data systems, high-speed internet access, social media and apps, Supervisory Control and Data Acquisition (SCADA) systems), for energy facility management, distributed energy resource (DER) integration,

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[1] Amended Scoping Memo, April 27, 2015, at Section 2.1 Number 4 bullet 2 (…energy production, transmission, distribution, and use; design, deployment, and utilization of onsite micro grids; construction and design of energy generation, storage and management facilities; implementation of demand response, ancillary services, grid services, advanced grid services; and interconnection issues, ownership issues for maximum effectiveness). http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151339864.

[2] Amended Scoping Memo, April 27, 2015, at Section 2.1 Number 2 (Collaboration between utilities saves ratepayers from double paying and can provide access to operational information about water and energy resources and facilities that are critical to their deployment and can increase the reliability and safety of service). http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151339864.

water system management, water treatment and the communications needs in SCADA and other systems, and steps to foster access to energy and communications technologies, and facilities that enable electricity system and water system management, water storage, treatment, and use, including for wildfire and other public safety measures, in a manner that addresses the water-energy nexus. Telecommunications enables the collection and transmission of data to facilitate energy, DER, and water facility and service action and analysis based on data.[3] Telecommunications including internet access describes all possible physical configurations of telecommunications services that provide access to voice, narrowband internet, and broadband internet, and data signals, regardless of the technology.

The Water-Energy-Communications Nexus will also evaluate the link between power access and communications facilities; broadband internet access for water storage, treatment, conveyance, recharge, recycling, managers, utilities, and users; and consider steps to promote such access to address the water-energy nexus. [4]

While the ongoing evolution of communications technology and deployment of communications technology may change the method of data transmission, access to reliable communications is increasingly critical to optimize water and energy facility operations and management as our state works to forestall, and in some cases to mitigate or adapt to climate change, and to reduce Greenhouse Gases (GHGs) associated with the electric, natural gas, and

[3] Amended Scoping Memo, April 27, 2015, at 7, pg 8.

[4] *Ibid.*

water sectors. The water energy telecommunications nexus explores the critical role of telecommunications for the optimization and management of water and energy to provide safe, reliable service, at just and reasonable rates, that helps achieve our goals of protecting the public and environment.

Today's Assigned Commissioner's Ruling introduces an eighth workshop report regarding the water energy telecommunications nexus into the record, inviting comments on the workshop report and related questions.

2. Proceeding Workshops

Eight workshops have been held in the Water-Energy-Telecommunications Nexus portion of the Water-Energy Nexus Proceeding, R. 13-12-011: August 13, 2014; September 10, 2014; July 10, 2015; October 30, 2015; June 9-10, 2016; September 9, 2016; September 29, and the final workshop was held on October 20, 2016. A report for the October 20th workshop is attached to this ruling in the appendix and we seek comment and reply on the workshop, here, as the following workshop report is incorporated into the proceeding. We request that parties comment on the topics discussed in the workshops and on the summary of themes raised in the workshops. Parties may also submit additional information and studies for consideration in the proceeding as appropriate and responsive to the proceeding scope.

October 20, 2016 Workshop

On September 29, 2016, the workshop focus was on the policy, operational, and safety imperative of meeting the technical communications requirements for distributed energy resources (DERs) and water resources and suppliers. Communication of data to the utility and/or CAISO is critical to water and energy resource and supply management at the distribution and transmission level. Both existing and new facilities face challenges and opportunities to maintain or establish communications throughout the chain of resources, facilities, customer, and operational nodes that need generate, use, and transmit, or should communicate data.

A. Investor Owned Electric Utilities & CAISO can help to optimize water and energy use with communications.

The Investor Owned Electric Utilities panel discussed how DER facilities larger than 1MW in size must communicate 3 data points with the utility every 4 seconds: voltage, real power and reactive power. Facilities larger than 9.9MWs must communicate the three data points above, every 4 seconds, as well as the following status: plant on, plant off, circuit breaker status. Data can be transported to the utility over various medium that today range from plain old telephone lines to VoIP or cellular services.

There is concern that many DER assets connected to the distribution grid sized at 99MW, aggregated together, do not currently communicate with the utility at all and mask load. In grid fault situations, facilities trip off, but load remains. As the grid comes back online, there may be large power swings to consider and manage. Today that management is largely done by controls on the electric grid, but communications that provides visibility would provide much-needed information about load conditions, while communications-based controls would reduce risks and costs associated with such events.

When communications go down for an electric facility, depending on the type of communications channel (Type A or Type B), either a person is dispatched to determine the utility plant status, the plant has seven days to fix the communications failure, or the plant is taken offline. Size and materiality of the facility are two factors taken into consideration in decision-making when communications from a facility to a utility go down. This is particularly true when communications may be down but electricity may still be flowing. Gaining visibility, in person if needed, and control, through grid protections and faults if not through communications, is critical to maintaining electric safety.

The utility "wire chief" interacts with telecommunications companies to report communications service issues. There is an escalation process for chronic communications service failures, though the time to repair some repeated failures on communications lines varies. To date, utilities do not report these failures to the CPUC. Utilities currently purchase many communications services from federal or state tariffs. Several utility representatives discussed concern about the impact of telecommunications service or facility retirements on the management and operation of their systems. These concerns escalate when a substitute service is not being offered in that location, the new service presents additional technical issues or has not been confirmed to meet electric grid- or DER operational standards, the new service increases costs, or there is no known replacement method.

Utilities discussed the difference between current grid safety and protection practices from the future grid safety and protection schemes that may come into being as smart inverters participate as grid assets. The difference between the current grid and the future grid with smart inverters used for hyper local grid protection is an infusion of communications.

The type of data that would be required by a utility may change if the utility were to use a facility more dynamically. A microgrid, for example, will need real time load and supply data to be continually processed by computers. High speed communications availability is a prerequisite for microgrid deployment, operations, and management. For a large utility, communications will enable the increased dynamic visibility and control of facilities. Rather than a microgrid-style centralized computer processing grid information, the DER future will more likely look like a distributed federated hierarchical system of control. Communications availability, speed, and latency issues proliferate in considering the enablement of this future system to come into being.

CAISO and the IOUs discussed company communications work-arounds used to increase ease and speed of new facility interconnection, as telecommunication services retire, sometimes creating service gaps, and often increasing costs of communications services across the energy utility space. CAISO requires direct telemetry to each resource participating in its market, accessible by connecting to the CAISO Energy Management System (EMS). CAISO first invented the RIG connection and, at the workshop, introduced its new Dispersive Communications Platform as an option for new resources to connect to CAISO's Energy Communications Network (ECN) to participate in the Energy Management System (EMS).

B. Agriculture, Water Utilities, Electric Vehicles, with communications, could assist in the water and energy optimization process.

California Department of Food and Agriculture discussed the SWEEP program's use of technology to promote water and energy savings in the agricultural sector. To optimize water and energy use and imbue the agricultural sector with technology, data access and analysis is required. From optimized water pumping, irrigation technology, automated systems switching on and off, soil moisture sensors, and other technology advances in the agricultural sector, they all require data communications and broadband. CDFA fields lots of complains that there is no broadband especially in the Central Valley where many specialty crops for the United States are grown.

The largest water utility in California, and third largest in the United States, Cal Water, requires various communications services to analyze data on pump efficiencies, water and energy consumption, water treatment, water pressurizing functions, among other uses, in all types of geographic regions in the state and the country. More data developed through more widespread Advanced Metering Infrastructure will help the utility to determine where in their system the 5-8% of water loss occurs, and gets booked as "non-revenue water." We're cautioned to consider the forced obsolescence of communications technology as the telecommunications industry modernizes in less than 10 year cycles, often in 2 or 5 year cycles at the longest. This is much quicker than meter technology modernization, pump modernization or other legacy facilities that rely on communications to continue functioning and can last from 10-50 years. The communications technology cycle is often out of sync with the GRC cycle, raising financial and reliability issues between GRCs.

California Water Service currently manages over a billion data points a day, while Metropolitan Water District manages over 9 billion a day. Automated Metering Infrastructure (AMI) installation will add to the data management needs of the utility. There is a tremendous amount of data moving from energy and water systems, and more data will be generated in the future, needing communications channels to transmit information, visibility, and control messages. The bottom line is that a new system cannot operate on a long term basis without communications.

Electric vehicles (EVs) will help conserve water in the state by reducing water and energy intensive processes to produce and refine oil. EVs can help to manage the grid as they are mobile if proper signals are communicated about grid conditions. This data management requires widely deployed, reliable, and affordable communications services. EV data development will be needed for grid management purposes, commercial purposes, taxation purposes, monitoring purposes, and to charge as payment is collected.

PowerTree, a multi-DER facility installed in multi-family homes, suggests that the Commission investigate some type of energy-oriented data communications services tariff that provides equivalent low cost data channel for systems that meet certain qualifications. For example an unlimited data requirement at a given speed at a low, flat cost, would benefit the grid, society, and the communications service provider, and anyone who is trying to do these projects because you can't do anything energy-wise on a distributed basis without lots of high speed data.

The DOE wrote a report in 2007 discussing building communications for utilities and we are just scratching the surface of that conversation in 2016. Several speakers recommended the Commission consider the role of communications for transmission grid protection and communication techniques for application to the distribution grid. Many utility engineers act to keep the lights on with little help from communications-connected DERs. The time has come where communications must be a ubiquitous asset, rather than a barrier to the clean energy distribution grid of the future. Integrated communications allow sensing, measurement, advanced controls, improved integrated interface design. Without modern communication and distributed applications, no smart grid will occur.

While visibility and control may have different requirements for DER communications with the utility or CAISO, market participation has requirements at the CAISO transmission level and is non-existent at the distribution level. At the transmission level, telemetry occurs every four seconds and is distinct from the billing system. At the distribution system, there needs to be a cost effective method of facilitating this step. If we anticipate that DER billing and control/ management are separate technical functions, they can be dealt with differently. For market development to occur at the distribution level, the communications requirements for market participation will need to be known and standardized.

A Workshop Report and the Workshop outline are Attachment A to this ruling. The video webcast of the workshop can be accessed at:

http://www.adminmonitor.com/ca/cpuc/workshop/20161020/1/

We seek comment on the Workshop Report, and suggestions about what steps the Commission should take in this or other proceedings to address the issues raised in this workshop.

3. Proceeding Meta-Themes, Water/Energy/Communications Nexus

The Workshops and record in this proceeding have highlighted the following "Meta-Themes." Please comment on the theme below and what action the Commission should take to address this Meta-Theme in the Water/Energy/Communications Nexus Proceeding or through other proceedings or actions. In addition, the workshop report, attached, identifies additional information for parties to respond to.

3.1. Communications for the Optimization of Water and Energy Resources and the Technical Requirements for a Distributed Energy Resources Services Market

All California water and energy facilities and services require accessible and reliable communications that meet applicable technical standards at competitive prices. Communications will be a prerequisite to establishing DER markets, and other market-based solutions to improve grid management and reduce GHGs. No proceeding currently is addressing the communications-based technical underpinning of a distribution resources market.

Water facilities and water utilities require energy inputs to provide service to Californians. The state's current energy generation fleet and transportation fleet utilizes water as a significant component. Six years of drought necessitates innovative water and energy management. Market participation will encourage forward motion more quickly. Discussing market developments will provide the correct signals about upcoming market participation potential.

Distributed energy resource[5] deployments across the state will require reliable communications facilities and services that meet energy regulatory standards to provide visibility about their operational status, and control necessary to operate as a utility service and a grid asset. Visibility and controls are necessary for DER managers, utilities, and CAISO. CAISO is concerned with frequency, security, and control. Communications with resources is the missing piece leading to safety concerns on the distribution grid. Utilities foresee a future where visibility and control could make market existence and participation a possibility but note the technical gap between today's grid and the dynamic grid future.

Questions: What actions should the Commission take to increase accessible and reliable communications at competitive speeds and prices that comply with applicable technical standards for California water and energy facilities and services, public safety provision, watershed protection, water system management, and economic development? Should the Commission

[5] Per the AB 327 definition, distributed energy resources include renewable generation, storage, energy efficiency, demand response, and electric vehicles.

require collaboration between the multiple utilities to address communications access? What policies should the Commission adopt regarding utility access to communications technologies and services to ensure safe, reliable service, at just and reasonable rates, and to maximize the operational potential of water and energy facilities and services? Through which proceedings should these efforts be coordinated or is a new proceeding required?

3.2. Other Meta-Themes

Are there other "Meta-Themes" that arose from the proceeding scope that the Commission should address in the Water-Energy Nexus Proceeding? If so, please suggest other Meta-Themes from this proceeding and appropriate Commission action to address that theme.

IT IS RULED that:

1. Comments and reply comments are sought on the attached workshop reports, meta-themes and questions, and workshop report themes and questions.
2. Comments shall be filed on Monday, October 31, 2016.
3. Reply comments shall be filed on Friday, November 4, 2016.

Dated October 26, 2016, at San Francisco, California.

/s/ CATHERINE J.K. SANDOVAL

Catherine J.K. Sandoval
Assigned Commissioner

ATTACHMENT A

Report on October 20, 2016

Water-Energy-Telecommunications Nexus Workshop

The video webcast of the workshop can be accessed at:

http://www.adminmonitor.com/ca/cpuc/workshop/20161020/

Smart Inverter Working Group 3 yr history – develop new requirements:
Frequency/Voltage ride through – current national standards do not require these functions yet, Local voltage support, ramp up
We don't want blips in the grid to disconnect DER fleet if it's very short, DER should resume to serve customer loads.
3,5,10 MW PV plants, might not want these facilities to start up in 1 second, might want to delay the start up.
Phase 2 and 3 – not yet finalized, and we do not have pinpoint requirements on data requirements for SCE yet.
Current data / distribution system requirements:
1-5MW: need voltage, real power and reactive power - serve load and generation customers and to ensure reliable power service to them, need these 3 pieces of info
If power is greater than 9.9 MW: add requirements data plus statuses: plant is on/ plant is off and circuit breaker status of power plant.
Resolution of information must arrive every 4 seconds to manage distribution system so no unknown distribution system issues.
How does the signal get to SCE: if resources is in remote area, signal sent via cellular, if resource is close by within the series, have Ethernet or Internet.
How do we want to use resources: for observability, for control, at the distribution level, at the transmission level? At each level the story could change. We want to be able to use resources at distribution and transmission level. Plan with the end in mind!
DERs can materially impact the distribution system as seen in SDG&E territory.
Traditional approach: Worst operating characteristic triggers the curtailment of the resource. That could change as a utility uses dynamic analysis (DRP) so that utility can treat resources more dynamically. The utility would need to provide

information to the resource regarding its needs to modify the output to enable the resource to become a grid support resource.

Materiality and size of the resource are two important characteristics to take into account in this decision-making process. Talk to material resources first and then down the chain to the smaller resources.

Duty cycles and performance requirements are different for small vs large facilities. For example, telemetry is required for resources 1MW and above.

Communications: <u>SIWG Phase 2 has a principled view</u> and designed around 1) what's good for the community at large and 2) communications costs should be minimized for all parties. If 1000s + of DERs, whatever solution should not provide a commercial advantage to anyone, should facilitate communications. Less need

<u>Transport of signal:</u> via Ethernet, internet – this is where the communications engineers come in.

<u>Application level protocol:</u> the actual messages, content of the signal, the transaction exchanges. This is where integration has been expensive! Move away from optionality in the communications signal. Remove optionality for clarity. And ensure security in the protocol by baking it. The Smart Energy Profile 2 (SEP2) Profile includes both protocol regarding the signal and baked in security to achieve Plug and Play interoperability. Be future looking so that we don't reinvent mid-way. SIWG did exhaustive hunt for standard and worked with standards body to make the modifications necessary to enable California and national standards to be harmonized. Don't reinvent the wheel so that we can have a plug and play grid.

<u>Where do we want to go: (not today or just a couple of years in the future) what is the DER goal for integration?</u>

Transmission sized generators can be 200MWs and up. Large size generators require lots of safety consideration for grid and workers. Distribution, also requiring of safety, maxes out interconnected resources at 20MW facilities. Look at communications and protections at the transmission level to see what we know and can apply to the distribution system.

[@31mins] With all of the sources integrated into the distribution grid, safety needs to be a priority. A fault on the grid, all resources generating into the fault will currently trip off. **If DER communications are implemented per the discussion above, proper and safe system operations of a radial distribution system (how the distribution system was originally set up) will look more like a mini transmission network in the future.**

Communications requirements for DER deployment are determined by the function of the DER:

Direct Transfer Trip as a protection device, when applied to a generator: if there's a fault on the system, device on Utility side will detect the fault and send a signal to generation source to trip it offline. Propagation delay of the Class A telecom signal of 5-10 cycles is tolerable though grid stability can be impacted by less than 3 cycles. (Important to consider if there's backfeeding from the distribution grid to the transmission grid.)

A telecom class A signal is a circuit that has to work before, during, and after a fault. In substation environment, this is a high energy environment, lots of electromagnetic transients can influence a data signal. Class A signals are utilized in the direct transfer trip protection scheme

[@34mins] Communications required for real time dispatch over future smart inverters so as to enable control over the grid environment and control over the breaker. Might not need Class A communication, but A will likely be preferred especially if a trip command can be sent out during fault conditions. (Utility may want to take a generator out or modify reactive power when a transient is going through the system.) Higher control requires higher level communication requirements.

Current communications requirements for SCADA systems: SCADA at the transmission system requires 3-5 seconds communications of signals. SCADA at the distribution level require less than 30 second communications. Operators can't lose visibility of facilities status for Control level use case.

Telemetry and Monitoring: 1MW or greater

Largest impacts on costs results in the request to put in new DERs in areas where historically there isn't a lot of infrastructure. Putting in a solar field, for example, you don't have a lot out there. Push back on communications paths that utilities are choosing. But the communication path is tied to the function of the DER.

For use of Direct Transfer Trip, traditionally use 4-wire class A communications scheme. But that's going away because telcos are shifting away from 4 wire. Now utility uses a T1 fiber, it provides the Class A communications that utility needs.

For large scale utility gen: require redundancy in communication to provide a protection scheme or telemetry information back to the control room.

Redundancy in Coms for large scale generators required to trip off generators to avoid large outages.

DERs are applying to connect to the grid (in PG&E territory) at a rate of 6k/month. Lots of generation hitting the grid. Safety and protection of the grid and the public must be priority. To that end, why has this been so complicated to work out?

[@43] Different generators have different fault current responses. Traditional generators are synchronous generators. Methane generators being set up at dairies as well as induction machines, utility engineers are very comfortable with these types of fault currents as they mirror traditional generators for which utilities have work since the beginning. Inverters don't put out fault current and traditionally relays can't detect the faults. If you set the relays too low, then you limit the output of the inverter. This has been a struggle for utilities to work out since 2008 when the inverter revolution began. Lots of testing has been done. If a generator can't detect an "in-section" fault, then a direct transfer trip protection scheme must be used to trip the generator. Communications path for required Class A telco service is very expensive. Can be prohibitively expensive for small generators.

[@45] Certified inverters produce little fault current so traditional relay schemes can't detect the fault. Under 1741 certification, the "anti-islanding" certification dictates that the power electrics component will trip off the generator. A portion of the inverter will use the "frequency bump" method. Frequency ride through, in the smart inverter, makes a protection engineer nervous because it may desensitize the anti-islanding protection function of the inverter causing it to be less safe. If the inverter utilizes frequency ride through, it may override the need for DTT on a circuit.

Sensitivity to trip can be de-sensitized by other generators and/ or other generators that are not certified and may cause a delay in tripping. Concern would be a run-on island that takes more than 2 seconds to trip off. Could jeopardize health/safety of the public. Not just equipment damage, it's a public safety and drought/fire issue. Arching line from a fault can start a giant fire.

Screening process for DER: Based on size of unit, look at configuration and loading of a line, if other machines are on the line. If no other machines and all inverters are certified, no DTT requirement. If larger than 1 MW, need telemetry which will require less than Class A telco.

Scaling up the screening process: Now a screening process being put in place to determine if there's going to be backfeeding into the transmission grid. Looking from transmission to the substation. Utility is seeing a convergence of drought and famers taking advantage of methane generators. Farmers using methane generators, farmer pump load being offset by certified units. Next door dairies is synchronous unit and that neighboring generator upsets DTT protection. Want o minimize interconnection costs and direct transfer trip protection scheme (DTT) but it's challenging especially when utility is so comfortable with DTT protection method.

Mix of generation can effect protection schemes. If new inverters effect UL certifications, might need to reinstitute DTT. Whatever utility comes up with in regards to communication pathways, utility might institute DTT as part of Communications schemes. Then it wouldn't matter what type of machine or inverter you have. With common infrastructure, piggyback protection infrastructures and embed them with the monitoring and control of DERs. **If utility can standardize or use existing standards to ease the telecom portion, then protection issues might go away!**
DTT telco circuits are leased from telephone companies for 20-30$/ month. Telcos are sun setting these services. AT&T is sun setting DS0s and DS1s and they're going away. There are no replacement technologies listed. Telcos don't have replacements. T1s might be a stopgap to get through the T0 migration, but they're going away in a few years. Ethernet services are 400$/month and there'll be an increase in telco bill as a result of meeting communications requirements as the telco services are being phased out. This will be significant for smaller generators that will similarly need to comply with telco requirements for visibility and control [telemetry, protection, control].
What is effective management of facilities for which you don't control communications? Difficult – larger generators require communications redundancy to ensure that signals make it to the utility. Only 1 communications path is under control of a communications company, one is totally under utility control. Must make sure that data is available and utility can control restoration.
Do utilities use 1 way situational awareness communications or 2 way communications for visibility/monitoring and control? Utilities all have bi-directional communication pathways. Receiver at generator in DTT protection scheme has a path back to utility to signal that receiver received the trip signal and what time the signal was accomplished.
Is there a plan for what the utility would do if telco services disappeared tomorrow? Is panic an answer? Working with AT&T to validate switched Ethernet service and it's applicability to data and transfer trip applications (protection). Promising technology but perhaps not available. If AT&T can't get a T1 line out to certain generators, not certain how a 10MegaBit service line will get out there.
How are you dealing with 10kw DERs aggregated from multiple sites to over 1MW in size? Telemetry requirements apply for facilities sized at 1MW or above. Many DERs at .99kws and there's no visibility of those now. Multiple .99kw facilities equal large MW DERs on the system and there's no visibility for them at all. This is a similar system to many small DERs aggregating to a large aggregator. Operators of utilities are starting to see the aggregate of 10+MWs

coming into transmission and operations are concerned that there is no visibility on that right now.
[@58mins] Currently - Operators concerned that DERs are masking load. Unclear what the load of the future is going to be and that's a concern because although individual DERs aren't a concern, the aggregate is: if 10s+MWs coming into a transformer and there's a fault in the transformer, the transformer is going to trip off. All DERs are going to trip off as they should. Then utility will test the transformer and all of the loads are going to come back online. There's going to be a big power swing.
If transmission grid faults and there are distribution grid circuits tapped on it, if transmission line fault, trips transmission, all DERs trip off, then transmission comes back on and all of the loads are still there. Power flow studies and grid stability studies need to be run correctly based on the actual loads on the circuit. Utilities are concerned that this isn't being done appropriately right now because of the DER load masking capability of DERs.
In the future, however - SIWG principles allows a second to ride through a fault, non-generation mode, if voltage goes below 50%. If voltage comes back within 1 second, generation will start up and ramp up to full generation. New smart inverter functions will prevent the tripping off circumstances of the backfeeding transmission grid situation above.
New Smart Inverter Function: If voltage comes back on w/in 1 second, generation will start up and ramp up to full generation.
DERs as they are today and with use of SIWG requirements of the future, grid operations are different: Loss of transformer or transmission line that has several tapped substations onto it. Where we're going now, there'll be significant backfeed. With SIWG Phase 2 low voltage ride through, can help with this situation.
Location matters – core concept created was the ability to have a grouping function. Sets of DERs can operate at a single unit so that a signal can be sent to both a single unit and also a group. As you move to DER, not just a blanket signal to the universe. Check out DER management work done by EPRI, under Brian Seal, who has gone through group DER management/ fleet management use case studies.
[@1:03mins] Current standards have max trip time and no voltage ride through at all. If voltage goes below 80% everything trips off within 2 seconds.
What communications types are we discussing to establish? Point to point pass through, self-healing grid, peer to peer? Answer: it depends, 1 size isn't going to fit all. Communications might depend on individual DER relationship with aggregator, the capacity to communicate with utility based on availability of

services. Under SIWG – "communication head end" might require multiple communication paths going from one or another or many operators, multiple communications over Ethernet or internet or both. [*Listen to afternoon discussion about mesh networks and multiple pathways ported through the same radio access box.*] Can't say one communication path over another, likely need multiple pathways. System has to be group aware to send right signal to right set of inverters/right DER resource.

Don't need to distinguish communications transport between DER resource types, as per AB 327 definition of DER resource. But system needs to be group aware to send signals to any DER resource or group of resources. Over time, all DERs need to converge. The question is – are we going to control every single DER interconnected to the grid or raise up one level of abstraction to have a manager at the Point of Common Coupling (PCC- between customer and utility system) that can say: I can manage everything here instead of having direct load control over millions of devices. All DER should be handled equally.

[@1:08mins] Question: There are long standing protocols about when you have a problem electrically, generators trip off. What happens if there's a communications fault and either communications becomes static-y or intermittent, or there's a sunny day outage as a result of a fiber cut. Does the DER or aggregator trip off? In Mendocino fiber cut, substations just disappeared. What happens when everything is fine electrically and the facility is producing electricity but there's a problem with communications?

Response: Operational calls have had to be made in this scenario already: If visibility is lost, depending on the size of the resource, the station has to be manned by a person. The person has to go to the facility and call up the operator/be on the phone with the system operator to tell the operator the status of the generator.

[@1:10mins] For the generator or DER, depends on the type of communications connection that has gone down, either type A or type B. Type A means the generator can't detect a fault and a direct transfer trip protection scheme is required for that generator to interconnect to the grid and be online. Since Direct Transfer Trip requires type A communications to always be on before, during and after a fault, generator will have to trip off immediately until communications pathway comes back online, unless there's a redundant communications pathway (often there are redundant pathways) and then the generator get 7 days to fix the original communications path. Unless that second communications path fails and then the generator must come offline immediately.

A type B communications pathway, the generator can see end of line so safety standpoint is covered, but from and islanding standpoint, they get 7 days to fix their communications issues.
For extremely important points on the transmission system, there are fully redundant paths from the substations.
At Metcalf, the communications path cut does impact the redundant pathways, so there isn't a single point of failure. PG&E acknowledges that they can't run a grid without data. They're currently going into SCADA at critical points and building in communications redundancy to prevent any single point of failure between the two new data transports to ensure data transmissions continue.
Unclear how long the utility can last with a loss of data, but it's important to note that smart inverters will help in the future because smart inverters will be able to help mitigate problems locally when that schema gets put in place.
Direct Transfer Trip protection schemes are detailed in the transmission interconnection handbook and referred to in distribution interconnection handbook. Interconnection handbook specifies when redundant communications are required for facilities based on size. Western Electric Coordinating Council designs communication circuit design to prevent single point of failure in communications circuits on the transmission side.
Watch out for distribution side cyber security attacks! Consider what happened in Ukraine where the distribution grid was attacked.
Smart grid and microgrids are communications intensive. To deploy a microgrid, you're going to need real-time communications on loads and generation. Communication and information intensive microgrids will need a lot of communications to match load and generation in a microgrid application.
[@1:16mins] Consider microgrids and new DER – depending on the application, the latency of communications, try to get off the concept that there's going to be 1 centralized computer handling everything. Push computation to the edge, to the substation, think about the future and push computation beyond the fence.
Coordinated distribution protection schemes are safety related along a feeder in the country but you can't backhaul the data. It's expensive to backhaul all data so there's a risk reward tradeoff. We need to move beyond the central computer doing it all idea. Consider, rather:
DISTRIBUTED FEDERATED HIERARCHTICAL SYSTEM OF CONTROL where control occurs at the control center and coordinates in areas.
Final question: If the future has DERs participating in a market where money is involved, how important is communications in this future and how do we move between today and that future that involves money trading hands with specific regards to the movement of data?

The missing part is the data. Today: there are several substations that don't communicate to relays at all to get events out of it. Can't do a basic phone call to a relay information in many circumstances. We're going to need a large communications overhaul to get to the future that you're describing because in some of our areas we can't even do the basics.
Control and metering and settlements are different processes. There's a distinction between metering and control systems in the transmission system with CAISO. At the distribution level, from a technical perspective, we're not there yet.
Metering doesn't have to be real time. CAISO has a metering system that pulls metering data. But telemetry is provided for control every 4 seconds and that's distinct from the billing system in the CAISO system. We need to figure out how to be cost effective. Anticipate that billing and control/ management are separate technical functions and they can be dealt with differently.
Metering might be a point sent every 15 minutes. But to control you're going to need data much faster than that. The technology isn't there to control millions of devices in the field. Need to go way beyond what we have now to make that happen.
Question: What do you do when you don't have communications from a substation and what do you do? Utility calls "Wire Chief" to call whoever the carrier is. Utility IT person and wire chief will trouble shoot the circuit. Rural areas are notorious for having poor communications. Utilities working around that by using ESAP but some protocols don't work on the workaround and there are latency issues with the utility communications work around.
Utilities not reporting communications outages to the CPUC currently unless PG&E looks like the bad guy because the communications carrier doesn't quickly fix the problem, then utility gets CPPUC involved. There is an escalation process if a utility gets red tags on the same leased communications circuit over and over again. There are weekly calls with carriers for chronic circuits. AT&T and Verizon/Frontier deal with 90% of PG&E circuits. There's an escalation process with carriers as utilities attempt to get service replaced but many situations there are bad splices/bad pedestals (communications technology), and seals are replaced on 1 pair and the next rainstorm knocks out the system again.
Utilities buying communications services off of federal and state communications tariffs.

2nd panel begins at 1:29mins.

I. CDFA

SWEEP program, 2014, first thought about the water and energy nexus from a funding perspective. Led by CDFA, the SWEEP program incentivizes growers to make greater use of water on farms by using technology. Program has to lead to water savings and GHG reductions. GHG reductions are the focus of the SWEEP program because the funding source is ARB cap and trade dollars. CDFA is working to implement irrigation systems to use less water and reduce GHGs. At 66Million dollars, CDFA is working with other agencies on drought mitigation and GHG reductions quantification.

SWEEP Program funds a host of technologies: weather based instrumentation to gage evapotranspiration, soil moisture sensors for adequate irrigation scheduling, pumps that are variable frequency drive systems to match pumps with load and move pumps from diesel to electricity to use other energy sources for solar/wind use (no takers wind). Program is successful and oversubscribed: in 2 yrs over 1000 applications total 100million in requested dollars, funded 362 projects at 34 million dollars through solicitations.

50% of territory is moving away from flood irrigation (lots of more water use) to drip irrigation due to water and energy benefits. However, all systems within the agricultural water energy network rely on huge communications piece. Weather system and moisture systems have to talk to computer to provide info to a grower who can automate turning systems on and off. Telemetry is a big part of these systems. For these systems to be efficient and effective, they need telecommunication and broadband access. CDFA fields lots of complains that there is no broadband especially in central valley where they grow specialty crops for the country. Lots of salad made in California. Next closes state on specialty crops if Florida which produces ½ of the production that California does.

Historically, federal and state money built surface water systems to flood grower fields with water. Now half of all farm acres are on efficient watering systems. Currently, farmers are getting water from groundwater pumping and there are new wells all over the state with pumps. Not efficient system and not sustainable as groundwater levels diminish.

Pilot project: is there a new venue to change the dynamic. Working with Dept Water Resources, the question is: can we target irrigation districts for water and energy nexus conservation measures? Irrigation districts supply water to farms around the region. Before the drought, all surface water systems brought water

to the irrigation system, and then flooded farmers' fields.[6] Now, there needs to be a pressurized way to get the water to flood the pressurized surface water system and in order to achieve this, lots of information is needed. Irrigation system needs to know when farmer needs the water. Communications systems are lacking so getting this data from farms to the irrigation system is challenging to enable. The current pilot project will see if type of project is going to work. One project might be funded to test this proof of concept.
The new sustainable groundwater act is trying to bridge famer/ irrigation district relationship and make it much better. Irrigation district pumps are variable frequency pumps at the districts and there's huge GHG reduction and energy efficiency possibilities available. However, tying these places together via broadband deployment to enable data access is a barrier to overcome. Growers are experimented currently with satellites that have limited data access. And other companies are being set up now to look at fields using drones to get telemetry. Data must be analyzed to send back to growers, and then sent.

II. PowerTree [@~1:42mins]

Communications issues for distributed energy resources and distributed systems are similar to challenges in VOIP seen globally. Power Tree is integrated solar PV, energy storage, EV storage systems put into multi-family residence. This multi-faceted facility is attempting to generate multiple revenue streams. PV can be purchased by tenants or offset EV consumption. It can use the EV as primary and most valuable revenue source, the company rents and controls a parking space to provide control for garage doors, lights, building access systems in cases of emergency and the system ties into mobile communications devices(smart phones) with an app of mapped charging stations and directions to stations. The facility prioritizes load/ prioritizes the EV because a vehicle provides access to hospital, job/income, children/education for life and in case of emergency. An EV should be treated differently than a refrigerator, lights, and pumps, because people need transportation above and beyond other things.
Use energy storage to provide resilience for EV usage but also the building If the grid is absent, for example, many sights can aggregate the storage as an aggregated resources for autoDR activity. The whole system is monitored so that

[6] Surface water refers to water that is found on the surface of the earth, like from rivers and streams, ponds, lakes.

station use is known at all times. All in all, there is a lot of data required from all of the systems.

The watchword of the PowerTree data communications build-out for the facility: fail gracefully, restart gently, forget nothing.

To Fail – expect that pieces of communications system will fail and that'll happen concurrently. There will be locations where grid is out and others are active. Locations where communications are out by the electric grid remain active. Be prepared for all permutations of failure. Build in full communications computing at each location to **monitor and measure** each location at as high a frequency as possible. Grid interactive battery and inverters can provide backup in a grid outage in 4 seconds. Data measures power production once a second. Measure EV charging continuously and report all data and track it back to central data base hosted by cloud AND proprietary data center that is protected and duplicated every 4 seconds. Report data to customers and CAISO on a 5 minute basis and report telemetry on a 4 second basis. In case of operational failures, and residence switches from the grid to the battery, business rules kick in to prioritize EV charging, elevators and other.

Facilities rely on UL 1741 equipment certification for equipment restoration as growth of installations occurs. Each site has 48kw discharge capabilities, 42kw of charging capabilities, and 120-25 energy on each one. They can aggregate to about 8mw from max charge to discharge (not counting controllable EV charging).

This company is seeking monetary pathways independent of the utilities.

Each PowerTree site has integrated, secured wireless interconnect connectivity built into the site at about 25-50 megabits bidirectional communications and communications transportation service is backed up with own battery and own system and build as wireless mesh network. Datacenter mesh network is built on same network so if primary internet exchange points have a problem, the entire communications system will continue to operate and update until the major communications outage comes back online.

Wireless communications in a compact space in the urban environment has been the best communications solution for PowerTree as it provides great redundancy and rapid restoring capacity. It was challenging, however, to find an economic path to get wireless resources.

First, PowerTree considered looking at cellular data service for its communication needs. However, the amount of data the system required, even for just slices of services, data requirements became noneconomic under cellular services provided by wireless carriers. Cellular data service would cost around 200$/month for data communications. Higher speeds wireless provider and not a cellular provider, for 50 megabits a month unlimited data, under 20$/month with unlimited data was the 1-off agreement that they came up with. And PowerTree co-markets the data service to building tenants to utilize and share the installed communications infrastructure.

For lots of distributed communications, data access and the cost of communications and the cost of data and data requirements is the make or break part of the startup DER business. If your communications services are limited, a new DER business will become impossible from a cost perspective. This is a particular area that the commission should look at: some kind of **energy-oriented data communications services tariff that provides equivalent low cost data channel for systems that meet certain qualifications. For example an unlimited data requirement at a given speed at a low, flat cost, it would benefit the grid, society, and the communications service provider, and anyone who is trying to do these projects because you can't do anything energy-wise on a distributed basis without lots of high speed data.**

III. CAISO [@1:56mins]

Cyber & telemetry focus + new alternative for customers to connect to CAISO: CAISO is wholesale, concerned with Transmission and Control. Has direct telemetry to devices through a RIG as well as Indirect telemetry through ICCP communications plant to plant. CAISO basically made this up.

Telemetry is required at CAISO if a facility connects to the CAISO market through the Energy Management System (EMS). Use AGC to balance frequency through direct telemetry. Facilities are telemetered every 4 seconds to bring information into EMS and keep the frequency of the transmission grid stable. When CAISO was formed, came up with the idea of the RIG. Following FERC Order 888, CAISO had to connect directly to resources recently divested from utilities that wanted to connect with CAISO. CAISO came up with a work around communications system for the generators that had to be secure and enabled CAISO to direct telemeter with resources. They came up with the idea of a RIG: Remote Intelligence Gateways is sometimes hardware, sometimes software, there are different providers. The standard was SSL and now it's called TLS. Secure channel for telemetry coming to CAISO's Energy Communications Network (ECN). Different relationship with telemetry than a utility b/c CAISO doesn't control it.

Heard from stakeholders that there's a challenge connecting with CAISO. Using a T1 communications circuit (business line over copers) to connect to CAISO ECN finding 3rd party provider for a RIG, maybe the resource was small and there was no one available to figure this out, maybe resource had to pay an ISP 2-

400$/month to manage the communications channel, buy a router on their side to attach to the MPLS, these expenses are absorbable for big entities but not absorbable for small entities that wanted to come into CAISO network. CAISO needed to find a new way to connect smaller resources.
DER Aggregate is a new type of participant at CAISO. Commissioning a new circuit was the most critical portion of connecting to CAISO in the New Resource Interconnection process (NRI). Can take over 200 days to connect to the CAISO and this is a long time. Have to get new entity into network model so the state estimator can be run and have visibility, a piece of this stumbling block is the communications portion. The problem with the delay in time is that customers are attempting to come into a market to make money, these customers have put money on the line up front to join the CAISO and time lost is money lost.
Encryption must be provided to safeguard customer data: DNP3 protocols had to be supported, plant to plant communications had to be supported (indirect telemetry = ICCP protocols) and the metering protocols.
IT wish list: network agnosticism. Work on public or private network. Handle any underlying protocol and not interfere with that protocol, no changes to any protocol standards, costs are low, have it happen quickly because there are more assets in the field that want to connect. Low complexity, don't need to hire anyone, can't expire every yr/2yrs, maintain this new solution reliably & remotely without having to go into the field.
[@2:04mins] Going live with first entities by the end of this year: 3rd choice of 3 choices

1. MPLS (multi protocol label switching) to ECN or the T1 Line. Plus digital choice
2. AT&T to the ECN edge
3. Dispersive technologies in the military- spread spectrum – new solution for the ISO over SDWAN (software define wireless area network).

For this 3rd way: "Four-wire" is going away, T1 is going away, there's going to be an Ethernet handoff from utilities and that's a big change. CAISO has to systemically secure telemetry systemically. [Basically: the information being shared is very important and cannot get messed up or messed with as it travels from the resource to CAISO so there has to be a lot of security built in.]
CAISO believes that they should be able to use the internet to transport information security. Three years ago, CAISO started to investigate this new technique and many hands are involved in it.
This 3rd option will be a plug and play secure gateway to handle data. It's a completely new way of handling a VPN or virtual private network: cloud

orchestration to make immediate decision to handle routing problems, congestion problems.
Take control plane of the router, move to the cloud, use cloud software functionality to handle the dataflow. Hardware still handling dataflow, but CAISO is more nimble in the Cloud to leverage control. It replaces VPN. Will secure the public internet. Provide NERC SIP Control at the WANlink. Prevents interlopers from snooping on the data in the middle of the data communication through the dispersive technology. Both channel and payload level security is better than SSL and DSL.
3rd way to connect with CAISO: cheaper, faster, more secure, for the DER market.

IV. Cal Water – largest water utility in California, 3rd largest in America

10% of operating budget is pumping water out of the ground, lifting out of ground, creating pressure to deliver it to houses + ensure water quality. Attempting 25% water conservation which leads to energy conservation. Pump selection and pump efficiency is important, what is the energy density per gallon of water required to get water to houses. This is all high data use for optimization. Ozonation of water doubles energy consumption on the water treatment side goes into disinfect water.
Communications of data use can be managed by AMR and AMI networks. Get water consumption behavior to customers and it can change their behavior regarding use of water and energy.
Water during the evening to save water and energy because there's less evaporation of water.
Revenue vs non-revenue water is water that you sell to customers and the water that you lose along the way. Nationally, 5-8% of all water pumped out of the ground is lost and wasted water and energy. AMR and AMI would help identify where that water is lost.
All tasks require data, data requires communications. Without the data you can't get to the optimization of the resources and systems.
Different data mediums used across the state: microwave, fiber, coper. Related to frequencies available on the radio side, they are managed through governmental agencies. Los Angeles has highest congested airwave frequency real estate. It's expensive to purchase frequencies to transport information. In rural communities, it's a bit easier.
MET used direct connect fiber or coper. Cal Water used radio for edge control. Push control out into the field as far as possible in case there is a problem and you lose communications. Push control out to the field so if you lose

communications, facilities continue to work until a person gets dispatched to go check out the system in the field.
There are power failures, communications failures, and redundancy has to be built in just in case. All places have generators and backup communications in case of failures to ensure continued delivery of quality of water in case of problems.
Analog to digital, frame relay to MPLS, forced obsollece3nce as there is reliance on telcos to provide service unless company builds its own microwave or fiber networks. Obsolescence of technology is primary driver of expenditures for communications networks. Communications technologies have short life cycles compared to pumps or boxes in the ground. Communications infrastructures only last max 10 years so there needs to be planning ahead. If there's going to be coordination across silos, and telco technology is almost obsolete before installed, that's a risky investment.
Consider standards for security! Look at NIST. We are in a cyber cold war and utilities, as a national asset, are a prime target.
Q: Do water pumps need constant communications? Push control out as far as possible so that nothing fails as a result of a communications outage. In a power failure, pumps have backup. In a power or communications failure, pumps will continue to work so you keep getting water.
Statement – 50 years of telco history that never exposes communications to the internet. Internal telco critical networks are not exposed to the internet. Lots of logging of every key stroke to control information flowing through the internet. Internet can be a significant risk for controlling significant infrastructure. Reply – there is no exposure to the internet. New technology can choose the best path of available paths. There is concern that CAISO will not have another option so has to be proactive. Unclear that there's another economical option that has been semi-formalized at this point. Systemic security and offering additional capabilities like multi path and multi transport modes must mitigate risks.
How many pumps are variable? There are 8 levels of efficiencies to consider for pumping.
CalWater is already managing over a billion data points a day, without smart meters. This is a relatively small amount of data for utilities. MET might have 9 billion data points a day. Oracle data bases manage
Control system data, is flow meter data ever second, 5 seconds, every minute. 12K IO points every second, 22—25K points at any single point in time must be managed currently.

Control vs Metering are different measurements: Energy is measured under milliseconds and high frequency systems. Water is a bit slower. Metering side of the house could be every 15 minutes.
Where technology retirements are occurring, especially rural areas, there is no other option. No wireless built out, no other technology options. What does that mean for the water ratepayers? The numbers come up in the various districts. There are variations in populations in different water districts where there are systems with few customers vs thousands of customers. This is the full spectrum of sophistication in investment. Some areas have no SCADA and only local control through a radio signal. SCADA is command and control, security, shut down – this is done at a supervisory layer. There are areas that do not have this. There is beauty in simplicity at times because during the fire when the power and water shut down, the pump kept working because it was controlled by radio and solar power. RTU is 5-15K installed. Backup systems with uninterruptible power supplies, true control systems plus data acquisition is 20-25K for a simple system. Sometimes doing the math among small groups of people, it doesn't pencil out but with a great population over which to spread costs, maybe it will. Bottom line, new systems cannot operate on a long term basis without communications. There is a tremendous amount of data moving from energy and water systems and this is an important topic to continue discussing.

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http://www.adminmonitor.com/ca/cpuc/workshop/20161020/2/
Afternoon takeaways:

- Look at what India has done in the water energy nexus as the country has had to deal with drought and the water energy nexus for over a decade.
- USA uses almost half of the world's water! Water utilities are super complex and need lots of communications.
- Electric utility AMI technology is 10 years old and we are not able to use it beyond reading a meter on the electric side. As we discuss DER integration, no one is talking about using AMI to integrate DERs, instead, integrators are discussing using private communications networks. When considering communications, we learned that the water sector that is much more complex than reading a water meter.
- We need to be aware of communications technology obsolescence as we must consider getting stuck using just purchased technology that by the time implementation occurs, it is obsolete.
- We ought to consider the burden of this integration feat on electric utility engineers who are discussing transmission grid protection and communication techniques for application to the distribution grid. Perhaps the utility engineer alone might not be the individual to solve the communications question on the distribution grid.

- Utility engineers have done a good job to keep the lights on and transmission needs keep the lights on. Utilities might not have the right money, technology and people to manage the right technologies.
- Utilities are fertile ground for technology experiments but we're at the point where we need communications at the backbone of what we want to do.
- Integrated communications allow sensing, measurement, advanced controls, improved integrated interface design. Without modern communication, distributed applications, no smart grid will occur. The DOE wrote a report in 2007 discussing building communications for utilities and we are just scratching the surface of that conversation in 2016.
- No one wants to join an electric utility if you want to work in high technology. Lack of manpower and talent in utilities for high technology.
- There is a culture of electric utility IT people and operations people not speaking to each other across silos.
- Always have to consider the business model and business case.

- Machines are not like humans and who can deal with communications delays like a delay in sending or receiving an email. Machines need the data to arrive immediately.
- The military, for example, needed a highly scalable, secure data solution that has to be mobile and behave autonomously.
- The Internet is packet, an envelope with multiple layers of security around it with the payload data at the center. Useless for machine to machine communications because machines need something terse that needs to be communicated for IOT technology.
- Nothing in the world of IOT or advanced energy resources can ever happen unless the communications channels are highly scale-able, highly secure, and disruption tolerant. For example, if your phone disappears and you need a n new phone, the new and old phone need to connect because the router is holding a lot of information.
- Everything we do with machinery is like talking to a meter. There is lots of data coming off of various machines, heading to a tower, for use.
- Look for a control system that works: Nature understands scalability and security and enables a ton of birds into the backyard and they all communicate
- https://www.slideshare.net/DaCostaFrancis/meshdynamics-high-level-overview
- http://www.slideshare.net/DaCostaFrancis/the-abstracted-network-for-industrial-internet-slides
- https://www.slideshare.net/DaCostaFrancis
- Fire response is just like War, light. Control systems and command centers need disruption tolerant communications networks.

- Electric vehicles with transportation fuels are 45% GHG emissions and have moved the most slowly towards GHG reduction.
- The CEC is helping to plan for the state's need to serve 1 million - 1.5 million vehicles by 2020-25 to decarbonize emissions by 80% by 2050. By that time we'll need EVs in all transport sectors: trucks, freight, rail, maybe aviation. All de-carbonization policies must work together & we need to power of clean vehicles with renewable electricity.
- EVs will save water by reducing energy and water intensive processes of producing and refining oil. DOGGR report, new from AB 1281, oil producers in the state must report on how they're using water: volumes of water produced by wells in the state, volumes of water reinjected, disposed of and stored. As a proportion of a total end use, oil and gas production isn't as big as agriculture and but a fraction of urban use but because we use water to produce oil in a drought stricken state, we will need to align water usage issues better to meet our de-carbonization path.
- 17 barrels of water used in the production of a single barrel of oil – good metric to use to identify how driving electric saves water and saves energy.
- Policies must be developed for communications between the new transportation sector and the grid to determine how are we sending messages between utilities and charging infrastructure to cars and drivers.
- In 2014, multiple agencies developed the V2G integration roadmap. This roadmap attempted to point toward a pathway to enable the communication between service providers, chargers, utilities, and vehicles, for eventual vehicle to grid charging, the ability of vehicles to act as charging and storage devices, to absorb renewable energy and defer utility upgrades.
- We need to better integrate electric vehicles and communications to get and use better information.
- Vehicles are only driven 4% of the time and the capacity to use vehicles when they are not being driven is driving a lot of the innovation and investment by mobility companies. Ability to swing the 4% capacity factor when EVs are off road provides lots of flexibility when the grid has excess capacity and not overloaded with other demand. This is important to consider as we increase deployment of EVs to meet the governor's goas, ARB emissions reductions goals and GHG reduction purposes.
- SB 350 requiring widespread transportation electrification to reduce emission of noxious emissions and pollutants in Non-Attainment Zones where ambient air quality exceeds healthy by Fed EPA. Targets needed to meet those health based air quality = 80% reductions by 2023. Not a lot of time to meet these goals. Need to enable resources to come onto the grid to meet this goal.
- Bloomberg and McKenzie analysis from last week's report expect by 2030, 2/3 of cars can be electric and 40% could be autonomous. Those are interesting trends that we need to understand how they work together and especially EVs as DERs.

- Utilities should care! Millions of vehicles with battery packs of 100 kwhs each enables lots of purchased battery storage for use. We can swing that load around.
- On a day where the CAISO map shows noon-hour negative pricing across the state, with the lowest negative price @ -50$ per kwh, shows that the state is spilling renewable energy now. This could enable the proliferation of infrastructure that can be used to charge our cars cheaply.
- EVs with ~350 kws may be coming soon as will combined charging system technology with an ability to refill a light duty vehicle in 15 minutes! Technology is quickly changing and the grid has to accommodate this new large load.
- EV data development will be needed for grid management purposes, commercial purposes, taxation purposes, monitoring purposes. It'll be very important that efforts across over the dozen agencies working on these issues signal to the auto manufacturers, charging providers, utilities that everyone be very clear in terms of what functions we need so that we don't need to develop new protocols/ standards to meet targets. We need to use existing technology. Echoing SD&GE, let's not reinvent the wheel.
- Data and communications are needed! We'll need Aps to locate charging infrastructure to see if in use. Chargers need to authentic charging sessions and be built into the charging station, utilities can send price signals like TOU rates for dynamic real time rates, for reliability purposes, CISO could send frequency response signals or frequency regulation signals at more granular levels so EVs can be utilized as a flexible resource. Meter accuracy standards are required.
- Data and communications are needed to schedule EVs into markets and into distribution systems. ARB requires energy use info to protect low carbon fuel standard and this can be monitored in concert with charging station and communications, monitor traffic movement etc.
- **Drive electric vehicles, save energy and water! For every gallon of gas that you don't use, you save 17 gallons of water! Lots of change in the next several years, we have to coordinate to meet climate change goals. We must leverage communications and DER protocols to develop markets.**
- Communications are needed for Smart Irrigation. Smart controllers and sensors collect environmental parameters to help an irrigation plan. For example, CalTrans using smart irrigation to reduce water use by 33% along highways.
- Communications are needed for Water Monitoring. For example, LADWP using communications technologies to detect and monitor water leaks resulting in 20-30% reduction of water lost due to leaks in the pipes.
- The solution to water leaks isn't just about connectivity, it's about analytics, sensors, data. Monitor leaks in all the pipes. Simple concept puts ultrasonic sensor on fire hydrants, on meters, close to the pipe without intrusion. The ultrasonic signal gets sent down the pipe and we watch for change in patterns in signals and waves. If the pattern changes, it means there's something to fix. AT&T will determine there's an area that needs attention. This technology has been piloted in LA and lots of interest across the country to mitigate 20-30% loss of water.
- Private LTE spectrum and networks to help control infrastructure, critical infrastructure: Commercial LTE network transfers data from power station to a data center for monitoring and

possible control. If there's an accident on the highway resulting in communications network congestion because there is only server in an area, loss of signal could make everything bad. This solution for power industry for mission critical infrastructure for electricity or water utilities offers a dedicated spectrum to manage critical infrastructure for 100% certain data traffic delivered thru network to the utility. The Private LTE spectrum possibility could switch between commercial and private spectrum at the same time. Solution can work on private or commercial spectrum to prevent the risk of congestion for the utility.

  - Satellite can be the backup for the backup for the backup. If you don't need a bazillion megabits of data, there are potential solutions that are economical based on location.

- Project AirGig is new by a few weeks and a solution from AT&T labs designing a solution for broadband over/around power lines. So electric utilities can inject technology and technology can guide the broadband signal along the powerline. The technology uses the powerline as a signal guide and travels along the powerline and the signal is amplified every hundred feet to keep or extend the range. No need for backhaul. If you have power lines you don't need backhaul. Another great concept, no electrical intrusion into the power line, no binding into the power line. Power the solution by the magnetic field that goes around the powerline itself. Emitting magnetic field is converted to power the electric signal. Could be for deployment of connectivity in rural and deployment. No need for backhaul. Domestic/international application. Hundreds of patents involved in this.
- Conclusion, there lots of innovation in the telecommunications segment for energy and water management. All innovations rest on the deployment of technologies, LTE, 5G to come (soon) pushing hard as possible in many countries around the world to solve power grid problems like SCADA data transport over IP and latency. 5 G is optimized against latency.

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CPUC Proceeding Presentations: No open procedural vehicle for discussion about communications technology or requirements for the interconnection of new resources to the distribution or transmission grids, for the development of market mechanisms.
Interconnection Proceeding / Distribution Resources Planning Process / Storage / CAISO Regionalization
PowerPoint Presentations attached

(END OF ATTACHMENT A)

CPUC October 20, 2016 Workshop

CPUC October 20th Workshop

Communication requirements for DER deployment is dependent upon function.

- **DTT (when applied)**
  - Telecom Class A - propagation delay of 5 -10 cycles is tolerable, if needed for stability $\leq$ 3 cycles.
  - Requires highly reliable communication to ensure the trip signal gets through.
- **Control** (Required for smart inverter functionality
  - Telecom Class B is adequate, A is preferred since trip command may be initiated during fault conditions..
  - Requires highly reliable communication for control and status, Communication latency is less of an issue than for DTT, however must have constant and consistent updates in order to accurately assess system conditions.
- **Telemetry/Monitoring**
  - Required for units $\geq$ 1MW (KW, KVAR, Volts, CB status)
  - Reliability and communication latency is similar to that required for control
  - Telecom Class B may be used, The larger the DER the more impact it may have to the surrounding system.

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Typical Communication Mediums

Function	4 Wire Class A	T1 Fiber Based	T1 Class B	Dedicated Fiber	Microwave	Unlicensed Spread Spectrum	Cellular
DTT	X	X	X	X	X	X	X
Control	X	X	X	X	X	X	X
Telemetry/ Montoring	NA	X	X	X	X	X	X

Not recommended
Possible Alternative
Viable/Recommend

PG&E

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With the proliferation of DER: 5k-6k/mo.

- Safety needs to be the primary protection goal
- Faulted conditions shall be detected and all generation tripped from the faulted circuit.
- Each type of generation has a different fault current response.
  - Synchronous – High Energy fault current with a well define fault current characteristic.
  - Induction – High Energy fault current quickly dampens out, the time delay may be extend if self excited by nearby capacitance by other means.
  - Inverter Based - Produces low level fault current typically 1.1-1.3 pu

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Methods of Fault Detection

- Synchronous generators utilize protection relays to detect faults and trip. Ability of the relays to detect the fault is highly dependent on generator size, location and system topography.
- If generator cannot detect “in section” fault DTT is used to trip the generator.
- Certified inverters produce too little fault current for traditional relays to be utilized. Therefore the UL 1741 “Anti-Islanding” certification is utilized to ensure generation is tripped.
  - Most common method is frequency bumping*, Note: interaction with other generation (ie machine based, or uncertified) may desensitize or defeat the scheme.*

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Developed DTT exemption process for evaluation of interconnections to remove the need for DTT.

- Utilizing certified anti-islanding for tripping.
- Based on size of generator in relation to load, other generation and generation type on line section.
- Synchronous generation does not implement UL 1741 anti-islanding methods, therefore traditional protection methods are required (this may include DTT if the generator relays cannot detect all in-section faults)

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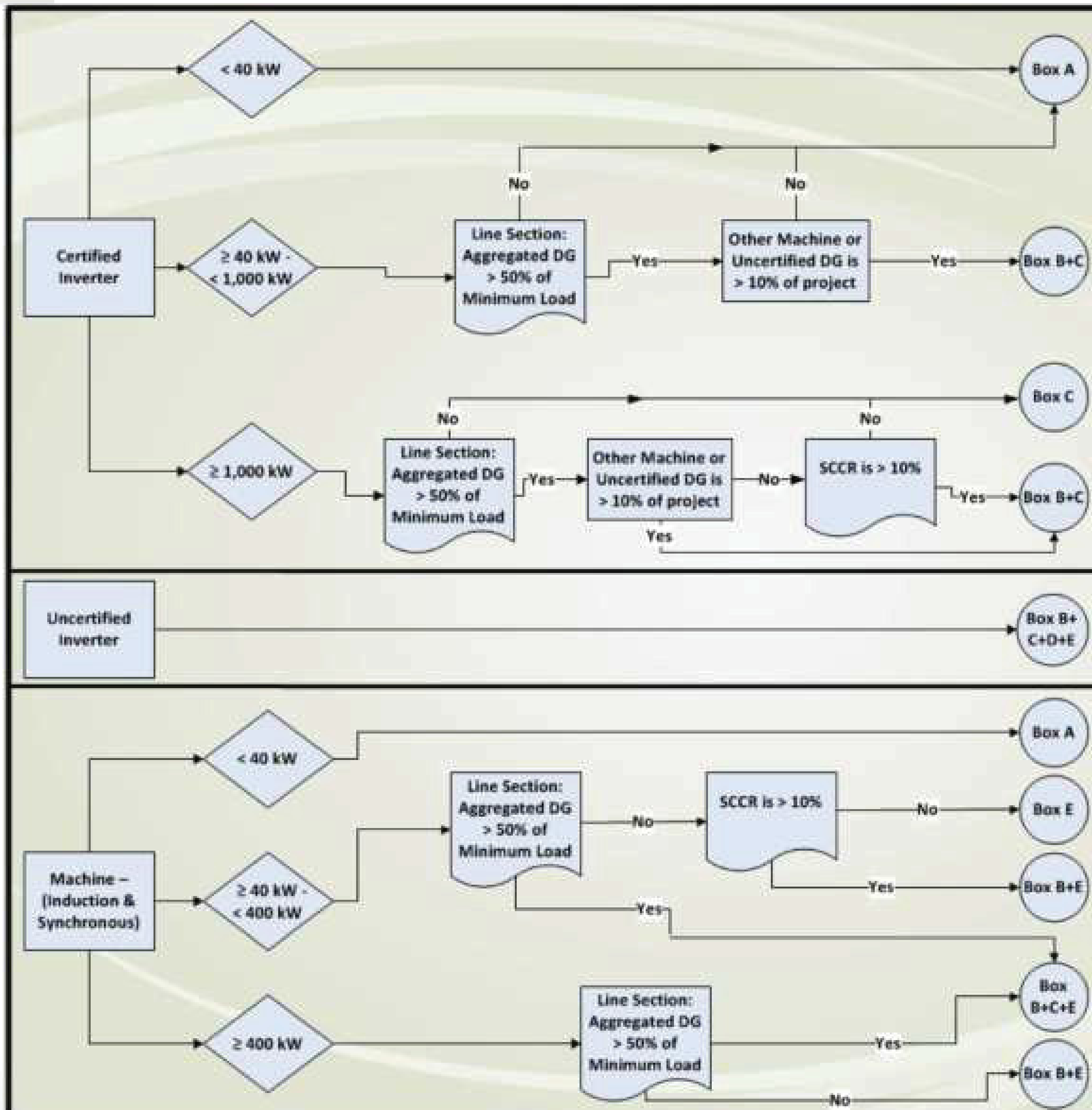
DTT Screening



Box A Requirements:

Direct Transfer Trip (DTT) and ground fault protection are not required

Box B Requirements:

Ground Fault Protection and Reclose Blocking

Box C Requirements:

PGE Scada Equiped Recloser

Box D Requirements

Customer side UG Interupter or OH Recloser to be installed if not present.

Box E Requirements:

Redundant sets of PG&E approved, protection relays installed by customer. These specific relay device numbers are 27, 59, 81O, 81U, 51V or 51C.

Notes:

1. PG&E, at its discretion may still require DTT on any DG system. (Especially machine based generators that cannot detect phase and ground End of Line faults.)
2. Phase and Ground protection are required to detect End of Line Faults.
3. These exemptions do not apply to certified and non-certified Inverters with Stand-Alone capabilities.
4. Transmission DTT requirements are independent and still apply.
5. For a line section with all certified inverters, reclose blocking will not be required if the first reclose can be delayed to 10 seconds.
6. If an existing uncertified DG already has DTT then this uncertified DG would not count towards the 10% limit for the "other machine or uncertified DG..." screen. Other uncertified DG with previously approved protection may still need to be re-studied on a case by case basis.

(END OF ATTACHMENT)

California ISO

CAISO Resource Communications

Communications for Optimized Water and Energy Management
CPUC Workshop – October 20, 2016

Thomas (Tom) Williams, Security Architect Lead

California Independent System Operator (CAISO)

When Is Telemetry Required?

A resource must provide direct telemetry and install equipment and/or software that can interface with the CAISO's Energy Management System (EMS) to supply telemetered real-time data when it:

- has a capacity of ten (10) megawatts (MW) or greater
- provides Ancillary Services (Spin, Non Spin, Regulation)
- is an Eligible Intermittent Resource (EIR)

How Is Telemetry Currently Provided?

Circa 2000, the CAISO invented the concept of a RIG.

- RIG stands for Remote Intelligence Gateway.
- A RIG is a field configuration that secures telemetry.
- SSL/TLS provides authentication and confidentiality.
- RIG and SCADA mutually authenticate using digital certificates.
- The SCADA system polls the RIG every four seconds.
- The communication network is (usually) MPLS.
- CAISO does not own the RIG.
- The CAISO market participant owns RIG security.

In the News

FERC has approved a new type of CAISO market participant called a DER aggregate.

The aggregation point is the market resource.

Telemetry to DER aggregates might use DNP3 or ICCP.

http://www.powermarketstoday.com/public/1615print.cfm

home | Article archive | FERC lets DER aggregate into Cal-ISO . . .

Search

FERC lets DER aggregate into Cal-ISO markets

June 03, 2016

Rules keep individuals small, aggregations above 0.5 MW

FERC yesterday approved Cal-ISO's proposal to let distributed energy resources (DER) aggregate to take part in its wholesale markets. The resources have to form aggregations of at least 0.5 MW to take part.

Existing generators that are 1 MW or more still have to become participating generators on their own and will not be able to aggregate into a DER provider. Generators between 0.5-1 MW will also not be eligible, unless they decide to terminate their participating generator agreement.

DR that participates as proxy DR or reliability DR may not participate under DER aggregation and will continue to run as curtailable demand.

Resources taking part in retail programs such as net metering also cannot take part in a wholesale market aggregation. Under net metering, resources already get benefits from netting their excess energy against subsequent bills so they have no energy to offer at wholesale, the proposal said.

The DER aggregations will be treated as the market resource, not the individual resources themselves. Aggregations can be at one pricing node or could spawn different ones but if they are across multiple nodes, they cannot be larger than 20 MW.

The aggregations will have to be located in a single "sub-load aggregation point," an area that reflects major transmission constraints and is inside each utility territory. That will ensure the DER aggregations do not lead to more congestion on the grid.

FERC accepted the proposal to establish a DER provider as a new type of market participant which it found will increase participation and competition in the markets. The DER will be carefully measured and will have to follow dispatch instructions as do other participants.

The ISO will have to file an implementation report at FERC within six months of the DER rules enactment. That will include information on the number of DER aggregations that have requested participation, the status of those requests, issues identified about them by distribution utilities and a discussion of any issues on the coordination of the distribution and transmission systems.

Expanding Metering and Telemetry Options

Market participants asked CAISO to evaluate new options for securing telemetry and metering to reduce barriers to entry, especially for aggregated resource models.

What We Heard from Stakeholders

- Prevailing theme: “We want to use the public Internet” (alternative to MPLS/ECN/WON).
- Network connectivity is the largest critical-path item for complying with CAISO participation.
- SSL/TLS does not by itself provide adequate security (alternative to PKI).
- CAISO must provide encryption to safeguard customer data.
- DNP3, ICCP, and metering protocols should all be supported.

CAISO Communication Opportunity

An alternative to PKI and MPLS for securing telemetry must meet the following criteria:

- Network agnostic (equivalent security on public and private networks).
- Protocol agnostic (handles any underlying business protocol).
- Customer does not need to maintain digital certificates.
- Initial and recurring costs are low.
- Provisioning is fast.
- Customer impact and complexity are low.
- Solution allows automated remote maintenance without reboots.

A New Alternative for Communicating with CAISO

CAISO market participants have a new option for providing operational visibility via direct telemetry:

- Dispersive™ Critical Infrastructure Software-Defined Networks (CISDN).
- CISDN runs on the Dispersive™ Virtual Networks platform.
- CISDN is an alternative to ECN/WON/MPLS, AT&T VPN (ANIRA), and PKI.

The first CAISO participants will go live on CISDN this year.

Revenue meters are next.

Key CISDN solution characteristics:

- Requires only a broadband connection (public Internet).
- No requirement for the participant to maintain a digital certificate.
- Pre-configured, turn-key, ruggedized appliance.

CISDN replaces legacy VPN and point-to-point encryption.

Security Advances of the Dispersive™ Platform

Dispersive™ CISDN systemically secures the public Internet.

- Resilience, reliability, and availability
  - Provides NERC CIP controls to WAN links
  - Aggregates multiple paths to forage available bandwidth
  - Cloud orchestration rolls away from congestion and compromise
  - Built around Internet Protocol (IP) as the *de facto* interoperability standard
- Integrity and identity controls
  - Authenticates and whitelists endpoints
  - Masks attribution
  - Assures non-repudiation
- Confidentiality
  - Splits session-layer IP traffic into independent streams to foil MITM
  - Separately encrypts packet streams using rolling keys
- Monitoring
  - Anomaly detection and response
  - Integrated firewall drops non-CISDN traffic

(END OF ATTCHMENT)

California Public Utilities Commission

Workshop: Water Energy Telecommunications Nexus
(R. 13-12-011)

October 20, 2016
San Francisco California

Vrinda Inc.

About Vrinda Inc.

Vrinda Inc. is a New York based "Energy, Utility and Transportation sector innovation firm" www.vrindainc.com

Technology

Solutions

Strategy & implementation

2009 Vrinda LLC founded
- Web based GIS product development

2011 Vrinda Inc. New York
- South Carolina Department of Transportation Road network geospatial map integration

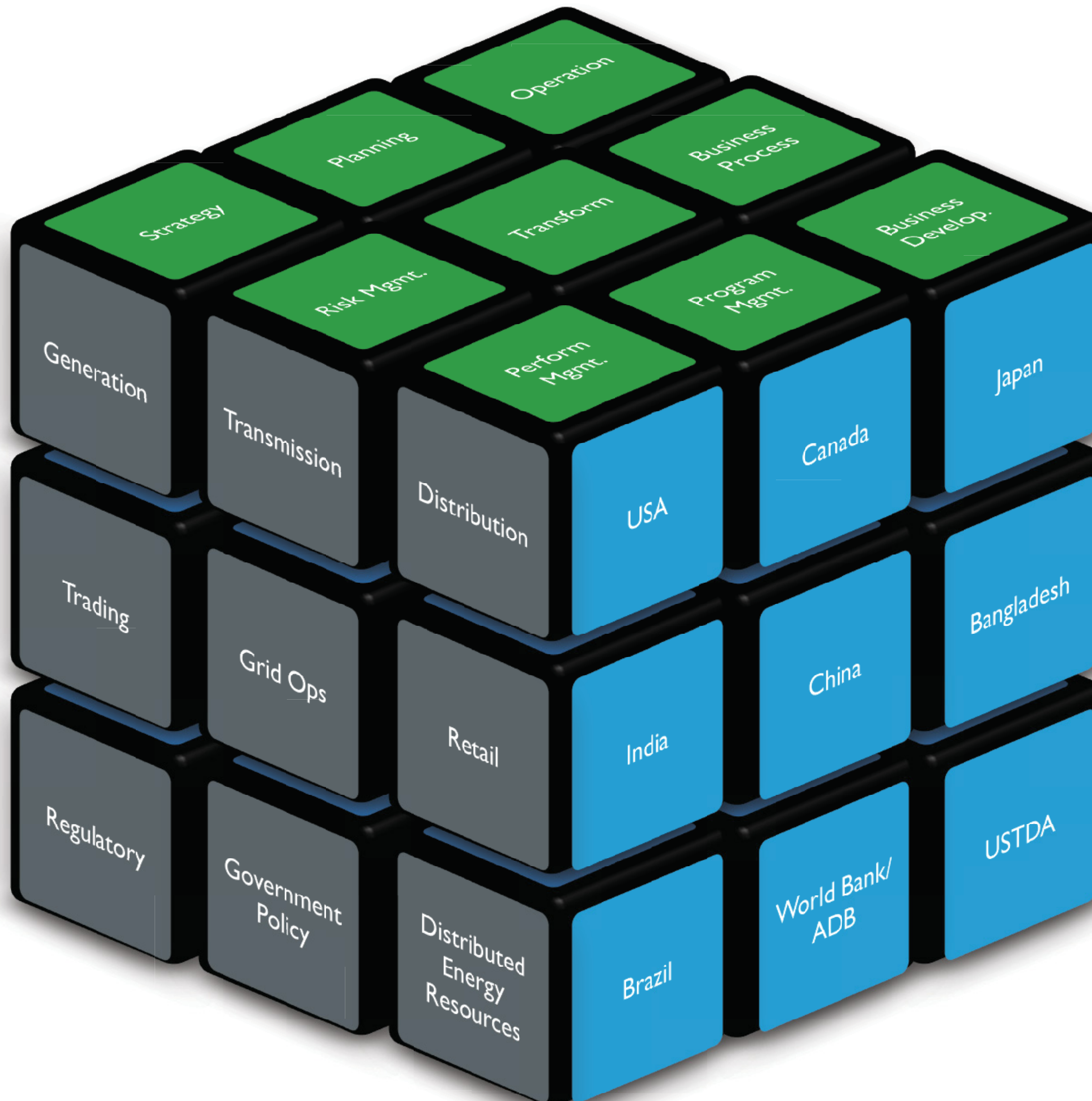
2014 Vrinda expands to Energy & Utility advisory
- Energy & Utility Advisory
- Strategy to implementation of Renewable energy led transformation

Navneet Trivedi
Credentials

- ✓ 24+ Years in Energy & Utility Sector
- ✓ 100+ Utilities
- ✓ Across the value chain
- ✓ In 7+ countries

Values

- Integrity
- Trusted relations
- Passion
- Commitment



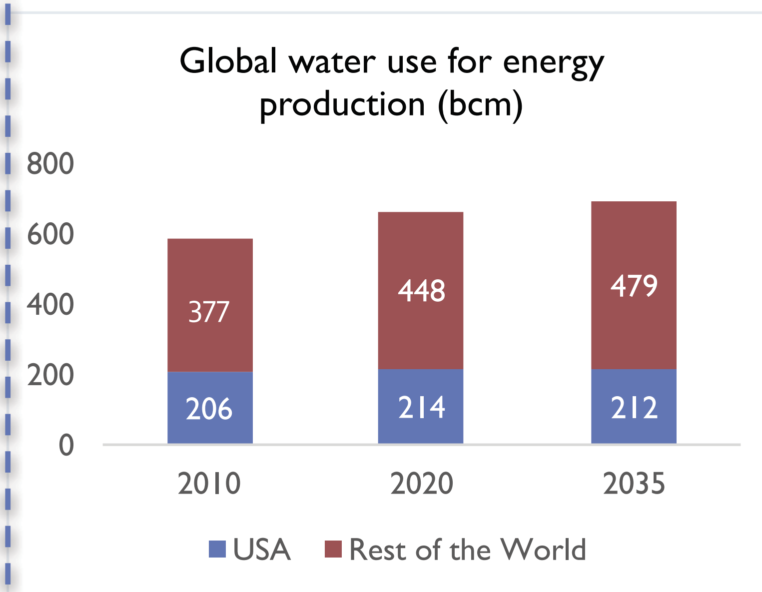
Agenda

- Context
  - Utilities journey with communication technologies
  - Key issues inhabiting growth of DERs/ technologies
    - Cyber Security concerns
    - Data privacy concerns
    - Use of technologies and institutional capabilities
    - Inter departmental trust and competencies
- Key questions
  - 3.1. Communications
  - 3.3. Distributed Energy Resources Require Communications to Interconnect to the Grid

Water-Electricity Nexus

- The huge amount of water is required to produce electricity and enormous power is used to process water. This is known water-energy nexus. Thus, sustainable management of either resource requires consideration of other.
- As per the *World Bank, 2011 & Census Bureau, 2011:*
  - Water withdrawal from all the sources in USA: 405,868 gallons per person and Electric power consumption in USA 13,246 kWh per person
- Water related electricity use in California is 48 TWh per year accounts for nearly 20% of the total electricity consumption (2005)

- According to world energy outlook, presently & going forward, USA contributes nearly 30% of the global water use for energy production.



Communication

Electric utility context

- Utilities have deployed multiple telecommunication technologies over the years ranging from PLCC to Wi-Fi
- Use of telecommunication was prevalent in transmission (PLCC/ Microwave, Fiber) but Distribution level communication was limited to Substations and offices
- Utilities took major initiative to replace electrometrical meters to Smart meters following ARRA funding ~ $3.4 billion a major push to reach end customers
- Smart meter technologies led to electronic meter reading and remote connect/ disconnect but technology largely failed to provide real time communications required for DER led transformation
- Limitation of gateway protocols like ZigBee further moved industry innovators away from AMI
- Now utilities are focused on making Smart Grid from Dumb Grid! But may not have necessary resources money, technology and people to manage complex technologies
- Meanwhile emerging application requirements such as water metering, DER integrations exposed inadequate communication capabilities and raises question about capability of utilities to manage and develop 21st century communication highways
- Further interest of telecom and ICT companies in the utility industry open new possibilities of getting communication technologies from players with core competencies in telecommunications

Communication
Water delivery context

ICT is strategic enabler in the process of developing innovative solutions to address the issues of water utilities. **Major areas for communication technologies in Water Management are:**

- **Mapping of Water Resources And Weather Forecasting**
  - Remote sensing from satellites, In-situ terrestrial sensing systems, Geographical Information Systems Sensor networks and Internet
- **Asset Management for the Water Distribution Network**
  - Buried asset identification and electronic tagging, Smart pipes, Just in time repairs / Real time risk assessment
- **Setting up early warning systems and meeting water demand**
  - Rain/Storm water harvesting, Flood management, Managed aquifer recharge, Smart metering, Process Knowledge Systems
- **In time irrigation in agriculture and landscaping**
  - Geographical Information Systems, Sensor networks and Internet

Telecom technologies deployed in Utility Sector

Wire-line Technologies

- Power Line Carrier (PLC)
- Broadband
- BPL (Home Plug)
- BPL (Home Grid)
- Copper UTP
- Optical Fiber

Wire-less Technologies

- Multiple Address System Radio
- Paging Networks
- FHSS Spectrum Radio
- Wi-Fi
- WiMAX
- ZigBee
- Multiple Address
- OSHAN
- 3G Cellular
- TDMA Wireless
- CDMA Wireless
- VSAT Terminal

Other Technologies

- Internet Protocol (IP)
- Internet2
- Fiber to the Home
- Hybrid Fiber Coax

Foundational Requirements

Integrated communication is the first step in building modern grid

- A wide range of technologies to be put in operation to achieve the modern grid. These technologies can be grouped into five categories.

Integrated Communications	Sensing & Measurements	Advanced Components	Advance control methods	Improved Interface & designs
Moderation of grid depends upon data acquisition, protection, and control	To allow users to interact with various intelligent electronic devices	There is need to specify technical requirement for the systems such as speed, redundancy and reliability	Control of a system should be designed to be as independent of that system as possible,	Standardization of various equipment in developing modern grid should be encouraged.

- Without communication no modern grid can be realized
- The communication systems utilized in the power industry today is very slow and too localized to support the integrated communications.

A Systems View of the Modern Grid- Conducted by the National Energy Technology Laboratory for the U.S. Department of Energy Office of Electricity Delivery and Energy Reliability **February 2007**

Barriers for the telecom in utility sector

Barrier	#	Description
No Universal Standards	1	Various technologies not able to work as integrated suite
Undefined Communication Architecture	2	The transition plans need to emphasize on how to reach future state
Regional & National demonstrations	3	Need to create interest, excitement in society to promote deployments.
Need for regulations	4	Regulations are required to ensure that investment in new technologies will not lead to losses
Unawareness among consumers	5	Lack of consumer education to create interest and motivations among the consumer group
Hesitation among vendors	6	Vendors are hesitating to invest in sensors, IEDs, DER etc. due to lack of universal standards.

A Systems View of the Modern Grid- Conducted by the National Energy Technology Laboratory for the U.S. Department of Energy Office of Electricity Delivery and Energy Reliability **February 2007**

Various concerns in adopting ICT

Are electric utilities best suited for managing ICT?

Key Challenges and opportunities

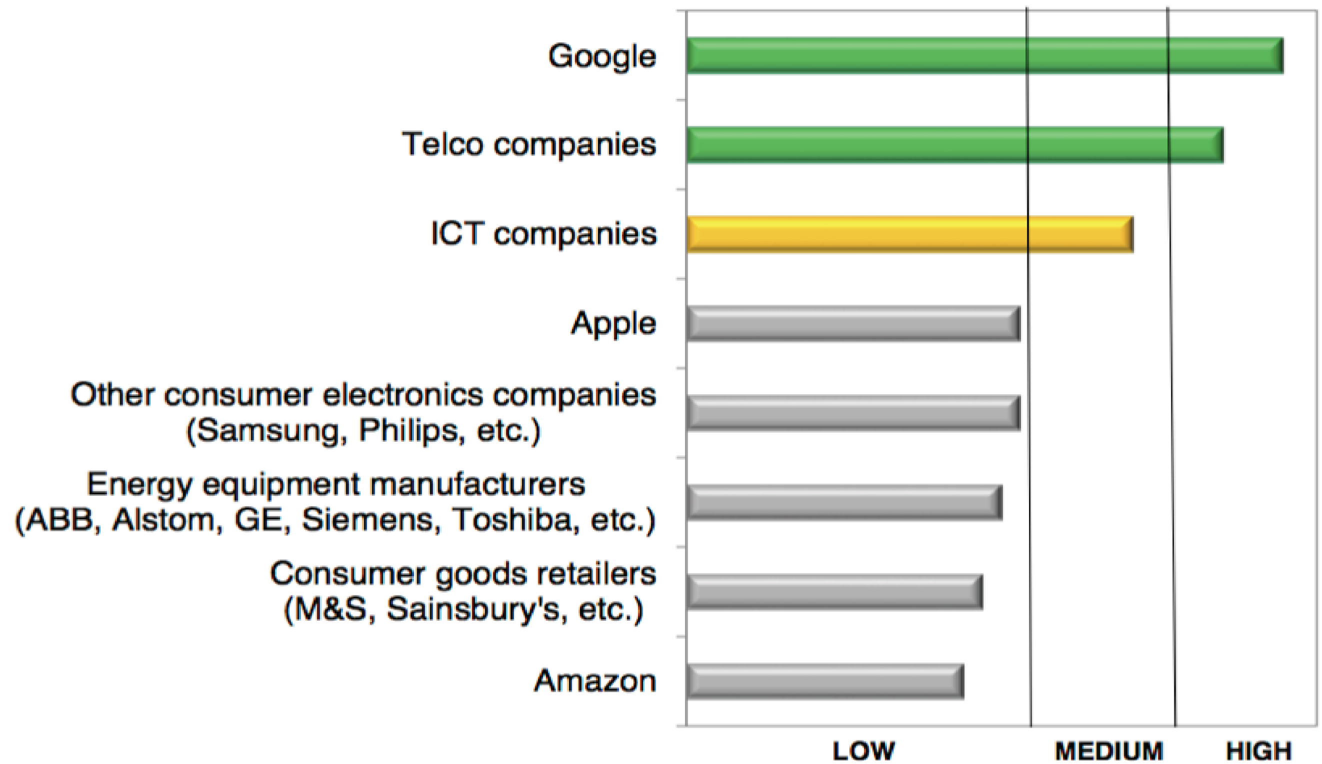
- Cyber Security and Data privacy concerns
- Use of technologies and institutional capabilities
  - AMI and limitations
  - Lack of manpower/ talent
  - Inter departmental trust and competencies
- Opportunities and new players
  - Changing pace of technology
  - Interest and entry of telecom players

Utilities have done remarkable job of keeping Lights on. But in the emerging paradigm its is more important for utilities to focus on core competencies and let experts take over communication. And there are alternatives…

Telecom and ICT companies are interested in utility sector

Nonutility Company Challengers in the Next Five Years

Q. *Within five years, which nonutility companies will pose the biggest challenge to your business?*



n = 35

Source: IDC Energy Insights, 2015

Key Questions

3.1. Communications

- **Theme:** Reliable communications facilities & services should be accessible to every consumer, DER managers, utilities and CAISO at competitive prices.
- **Question 1**: Steps to be taken by Commission in order to increase accessible & reliable communication for California water and energy facilities & services?
  - Explore independent universal access to communication network
  - Explore "Infrastructure as a service model" for physical equipment's, bandwidth/ frequency sharing
  - Investigate real cyber security threat and classify them according to application/ data.
- **Question 2:** Is it require to file the tariff by carriers specifically for energy facilities for better management?
  - Let service providers define revenue models they see fit to recover
  - Commission must ensure transparency and establish floor price to protect customers
- **Question 3:** What actions should the Commission take to leverage investments through federal communications expansion programs to optimize the distributed energy resources interconnected to the electric grid to manage the water and energy needs of Californians?
  - Use available funds to test out business models described in question 1 above
- **Question 4:** Should the Commission require communications tariffs to be filed for distributed energy services, other energy or water services and facilities?
  - Don't believe there is a need for a specific tariff. If technologies standards are interoperable and advantage can be taken of any available communication media then no special treatment is needed

Key Questions

3.3. Distributed Energy Resources Require Communications to Interconnect to the Grid

- **Theme:** DERs need accessible and reliable communications at competitive speeds and prices to meet CPUC, CAISO, FERC, NERC, and other requirements for visibility, management, operation, system and user optimization.
- **Question 1:** Steps to encourage deployment of communication facilities for DER?
  - Allow third parties to access multiple communication technologies to deliver data and visibility to DERs
  - Encourage aggregation model and direct utilities to accept information from multiple providers in a system agnostic manner
- **Question 2:** Affect of standardization of DER's communication on Commission's action & DER market?
  - Standardization is a ideal outcome but push should be on inter-operability
- **Question 3:** How does the technical environment of electric facilities affect communications needs and access?
  - No view
- **Question 4:** Are current protocols sufficient to notify DERs operators and users about communications outages that affect their resources?
  - No view

Key Questions

3.3. Distributed Energy Resources Require Communications to Interconnect to the Grid

- **Question 5:** Is the NORs standard sufficient to notify system outages to DERs producers & users?
  - **No view**
- **Question 6:** Steps to be taken by Commission to notify about the communication outages DERs producers & users?
  - Commission can set penalties and uptime requirements
  - Commission don't need to create a real time monitoring and notification system
- **Question 7:** Should the Commission host the web-site or mobile application to report the communication or electrical outages and to facilitate access to the CPUC's Consumer Affairs Branch?
  - Commission should ask providers to make available links to their outage maps and may publish them on its website.
- **Question 8:** How should California leverage deployment of communications facilities to households funded by the federal programs including but not limited to CAF, and state programs to provide reliable communications for distributed energy resources and electric/alternative fuel vehicles and charging stations?

APPENDIX

Communication Investment proposal by California Utilities

- **PG&E** is currently working on project to implement Telecommunication Architecture to meet near term and long term telecommunications needs by developing and implementing a multi-tier, multi service telecommunications infrastructure architecture, consisting of a core and an edge network. This project is expected to complete in 2017 and value of the project is $ 10.5 Million.
- **SDG&E** proposed project on Monitoring, Communication, and Control Infrastructure for Power System Modernization for the second EPIC triennial investment cycle. This project will test monitoring, communication, and control infrastructure to identify best practices for commercial adoption and deployment in the power system.
- **PG&E** proposed project on Enhanced Smart Grid communications. This project seeks to evaluate these license spectrum providers not yet widely tested or adopted, compare the benefits to existing infrastructure, and assess their ability to provide for future envisioned smart grid communications and customer services.
- **PG&E** has also proposed project on Smart Grid communications path monitoring. This demonstration will evaluate more efficient communication paths for AMI-related messages, including methods to clear potential interference, congestion, validate proper authorizations, and grant clearances for sending message over a secured communication path.

Communication Investment proposal by California Utilities

- In 2012-13 EPIC Investment plan, initiative was taken to <u>Develop Smart Grid Communication Systems that Interface with Customer Premise Networks and Distributed Energy Resources</u> included applied research for communication interfaces between smart inverters and utility distribution management systems (DMS). But this initiative was not implemented because SIWG is still developing recommendations for inverter communications which may also apply to other distribution equipment. Therefore, **2015-17 EPIC will address communication interface for smart inverters.**
- In 2012-2014 EPIC Investment Plan, funding initiatives were included for vehicle to <u>grid communication interfaces, distributed storage through second-use EV battery storage applications</u>, and battery recycling. **The objective in 2015-17 EPIC investment plan is to leverage the technical advancements as result project awarded in earlier plan.**

Advancement in Communication technologies in semi-urban & rural areas

- <u>Digital 395:</u> This project includes building of new 583 mile fibre optic network between Barstow, CA and Carson City, NV that will mainly follow the Highway 395 corridor. This will enable rural communities to aster Internet speeds.

There is need to enable internet usage among rural communities, especially farm work communities. There are various advancement that has happened in agriculture sector.

- <u>Sensor Technologies & Precision farming:</u> Data gathered through specific ground sensors can provide information about their crops, therefore can improve local productivity. It can also lead to optimizing farming inputs and time spent by the farmers.
- <u>Digital Financial services for farmers:</u> DFS-for-agriculture projects show farmers involved in trainings are benefitted from taking advantage of financial opportunities.
- Use of satellite imagery to capture information about the ground.
- High speed railroad will also be required to improve the rural communication technology.

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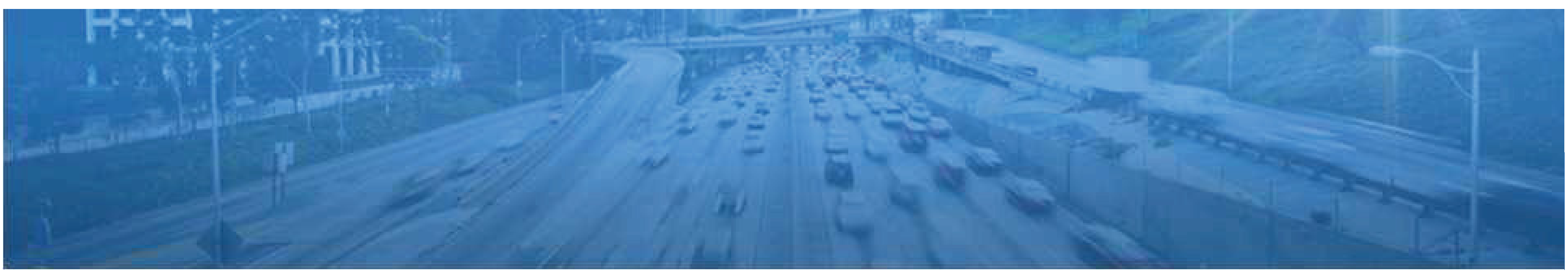
Cross-Sectoral Benefits of Integrated Plug-In Electric Vehicle Resources and Infrastructure

October 21, 2016

Noel Crisostomo
Air Pollution Specialist
Fuels and Transportation Division
California Energy Commission



California's Policy Goals and Objectives

Policy Objectives	Policy Origin	Goals and Milestones
Greenhouse Gas Reduction	AB 32, Executive Order S-3-05, Executive Order B-30-15, and SB 32	Reduce greenhouse gas emissions to 1990 levels by 2020, 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050 in California
Petroleum Reduction	California State *Alternative Fuels Plan*	Reduce petroleum fuel use to 15 percent below 2003 levels by 2020 in California
Low Carbon Fuel Standard	AB 32, California Global Warming Solutions Act	10% reduction in carbon intensity of transportation fuels in California by 2020
Air Quality	Clean Air Act	80% reduction in NOx from current levels by 2023
Renewables Portfolio Standard	Executive Order S-21-09, Executive Order SB X1-2, and SB 350	Goal of 33% renewable electricity generation by 2020 and 50% by 2030
Clean Energy & Pollution Reduction Act	SB 350	Transportation electrification that target charging infrastructure, underserved communities and vehicle grid-integration opportunities.
Increased ZEVs	ARB ZEV Mandate and Executive Order B-16-2012	Infrastructure to accommodate 1 million ZEVs by 2020 and 1.5 million ZEVs on California roadways by 2025*
Integrated Energy Policy Report	SB 1389 (2002)	2014 IEPR: Chapter 3 recommendations for EV infrastructure deployment

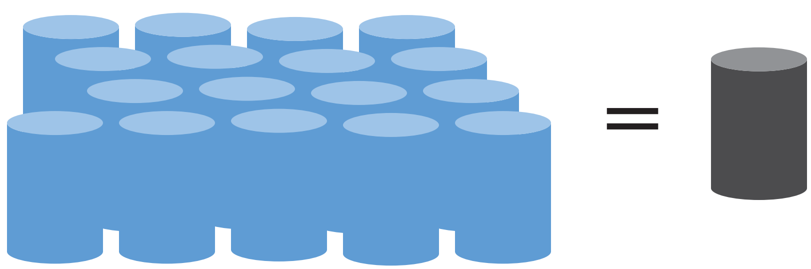
*Senate Bill 1275 (De León, Chapter 530, Statutes of 2014) subsequently established a target of 1 million zero-emission and near-zero-emission vehicles in California by 2023, as well as increasing access to such vehicles for disadvantaged, low-income, and moderate-income communities and consumers.

Oil Production is Water and Energy Intensive

Water Use in California Oil Production (AB 1281)

Volume	Acre-Feet	Portion Suitable for Domestic & Irrigation	Portion Untreated
Produced	208,747	2%	7%
Injected	184,345	2%	1%
Stored	9,406	11%	48%

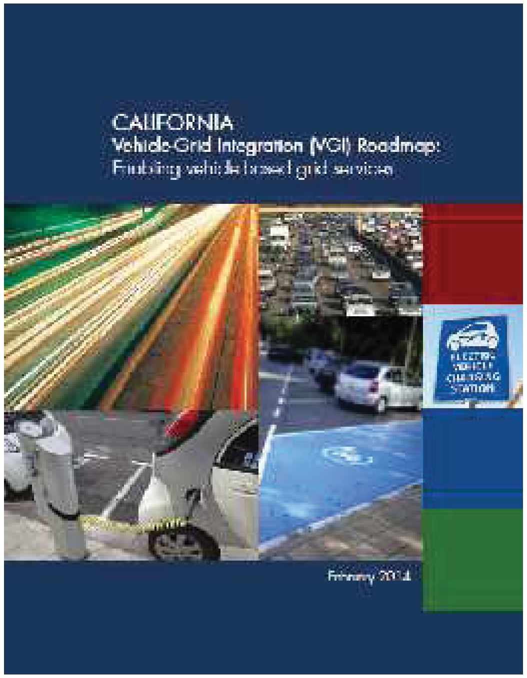
In the first half of 2016, developers used 1.6 B barrels of water to produce 95 M barrels of crude



+ Embedded energy to transfer and treat water and move, refine, distribute oil end products.

Sources: DOGGR, U.S. EIA

Communicating with Plug-In Electric Vehicles



[Vehicle-Grid Integration will] enable service providers and utilities to ***manage vehicle charging and discharging to help maintain the stability of the electricity grid*** while preserving drivers' mobility...

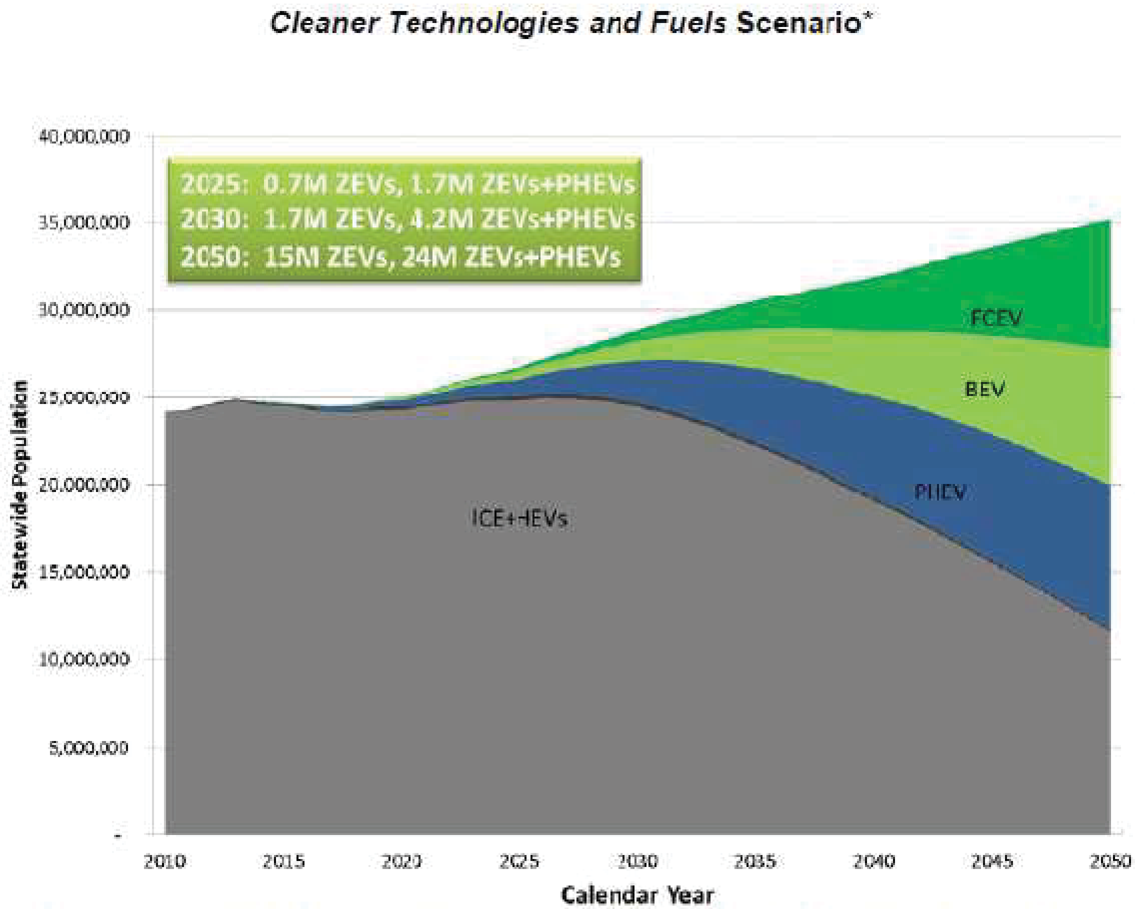
- 2016 ZEV Action Plan

Improving Resiliency

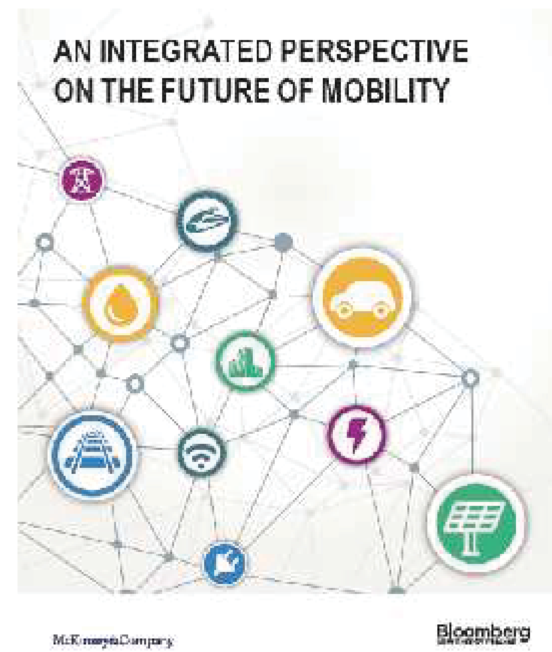
Integrate big data and shared GIS data to better assess impacts of [government] transportation adaptation plans to ***automate and modernize information that can be assessed across sectors***.

- Safeguarding California

ZEVs and Mobility Data will Proliferate



*Vehicle populations in the *Cleaner Technologies and Fuel Scenario* does not include the additional ZEVs from Further Deployment measures

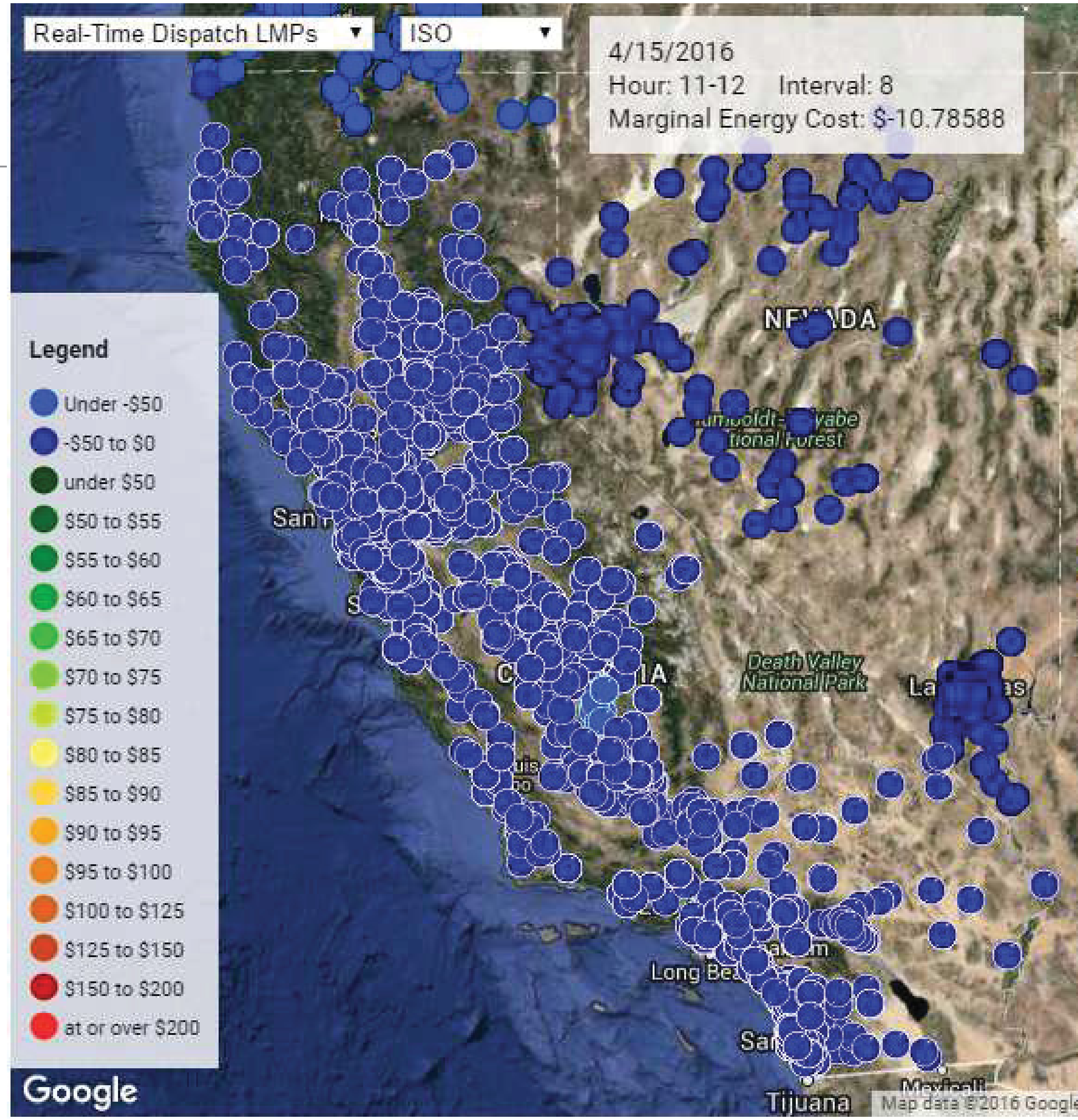


How many of these vehicles will be Autonomous, Connected, Electric, and Shared?

Sources: CA RB 2016 Mobile Source Strategy, Bloomberg/McKinsey

Grid Integration

Sunny by mid-day in the Central Valley, with a chance of negative power prices Statewide...



Source: CAISO Price Maps

Energy & Public Policy Uses of Transport Data

- Locating available **charging infrastructure**
- Open and **authenticated access** to charging sessions
- **Charge control** according to Time-Of-Use (TOU) rates
- Provision and settlement of **grid ancillary services**
- Accurate **receipt of commercial sale** of electricity as fuel
- Reliable operation of the grid by **scheduling PEV demand**
- **Validating credits and revenue** for Low Carbon Fuel Standard
- **Analyzing network** utilization, maintenance, and deployments
- Improving load and generation **forecasting and planning**
- **Monitoring traffic** flows/congestion, road capacity, and tolling
- **Allocating construction** costs to drivers proportionate to use

Key Takeaways

- PEVs reduce GHG 70% and ozone-forming pollutants 85%, more so with more renewables.* In addition, every gallon of crude oil displaced by avoids the use of 17 gallons of water and associated processing energy requirements.
- State electric transportation policies can reinforce the technology trends propelling "Mobility As A Service," increasing the need to accommodate new data crossing power and telecommunications.
- Coordinated policies and market signals are needed to ensure that utilities and industry design products and programs that integrate with DER protocols efficiently.

* Per SB 350, Public Utilities Code 740.12(a)(1)(I) citing CEC/ARB Alternative Fuels Plan

energy.ca.gov/transportation

Thank you!

Questions, comments, and feedback welcome.

noel.crisostomo@energy.ca.gov

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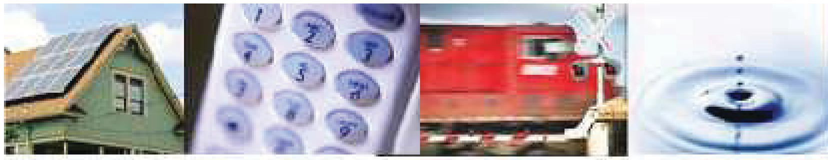
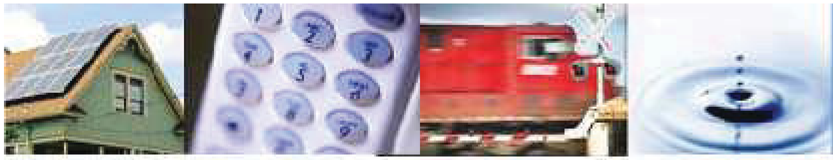


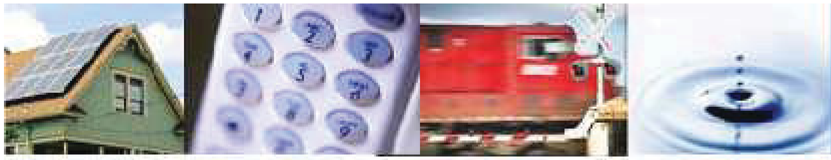
Mandate: California AB 2514 (Skinner, 2010)

- Targets: Required CPUC to consider establishing storage procurement targets for investor-owned utilities (IOUs), and required municipally-owned utilities to consider the same. Targets to be achieved by EOY 2015 & EOY 2020
- Eligibility: Thermal, chemical and mechanical storage eligible, for multiple uses, in the customer, transmission and distribution domains.
- Policy Objectives: IOUs must demonstrate that their storage procurement will support integration of renewables, or contribute to GHG reductions, or grid optimization.
- Barriers: CPUC to consider storage policy and regulatory barriers in proceeding.



Mandate: Energy Storage Procurement, by Utility

	2014	2016	2018	2020	Total
SCE					
Transmission	50 MWs	65 MWs	85 MWs	110 MWs	310 MWs
Distribution	30 MWs	40 MWs	50 MWs	65 MWs	185 MWs
Customer	10 MWs	15 MWs	25 MWs	35 MWs	85 MWs
PG&E					
Transmission	50 MWs	65 MWs	85 MWs	110 MWs	310 MWs
Distribution	30 MWs	40 MWs	50 MWs	65 MWs	185 MWs
Customer	10 MWs	15 MWs	25 MWs	35 MWs	85 MWs
SDG&E					
Transmission	10 MWs	15 MWs	22 MWs	33 MWs	80 MWs
Distribution	7 MWs	10 MWs	15 MWs	23 MWs	55 MWs
Customer	3 MWs	5 MWs	8 MWs	14 MWs	30 MWs
TOTAL	***200 MWs***	***270 MWs***	***365 MWs***	***490 MWs***	***1325 MWs***



R.15-03-011 – Storage Policy Rulemaking

Track 1 (complete):
1) Procurement Best Practices
2) Refinement of the Consistent Evaluation Protocol
3) Flexibility of Energy Procurement Targets Between Grid Domains
4) Safety Standards
5) Energy Storage Target Tracking for Community Choice Aggregators and Electric Service Providers
6) Cost Recovery
7) Coordination Across Agencies

Track 2 (current):
1) Consideration of Technology Eligibility
2) Multi-use Applications
3) Station Power for Energy Storage
4) Community Storage
5) Target

Track 2 Policy Issue: Multi-Use Applications

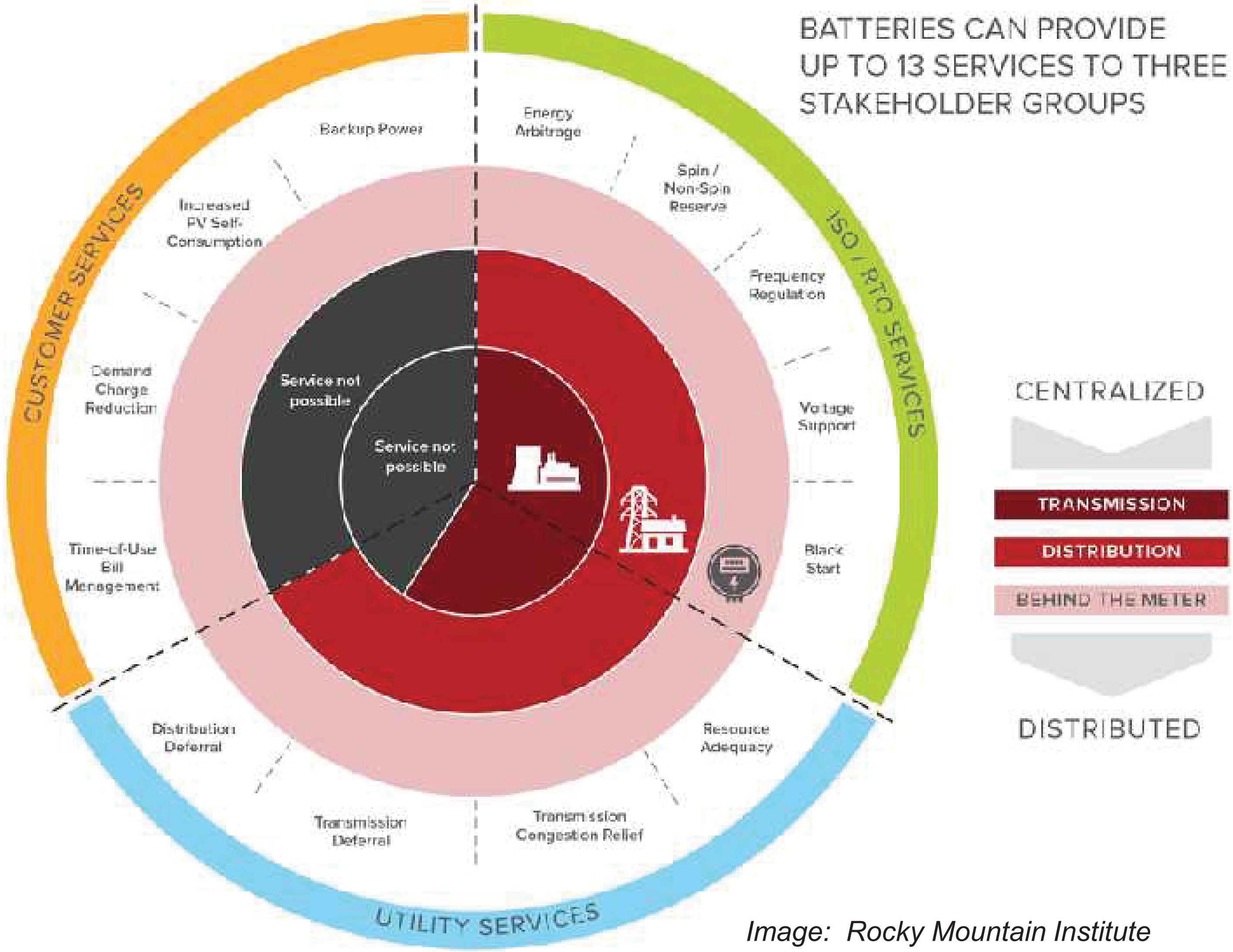
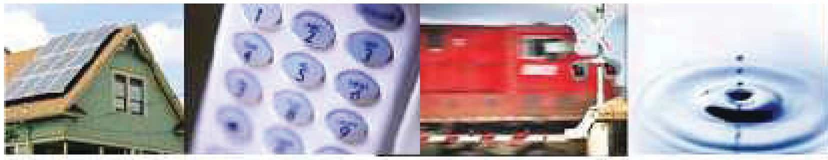


Image: Rocky Mountain Institute



Thank You!

Rachel McMahon
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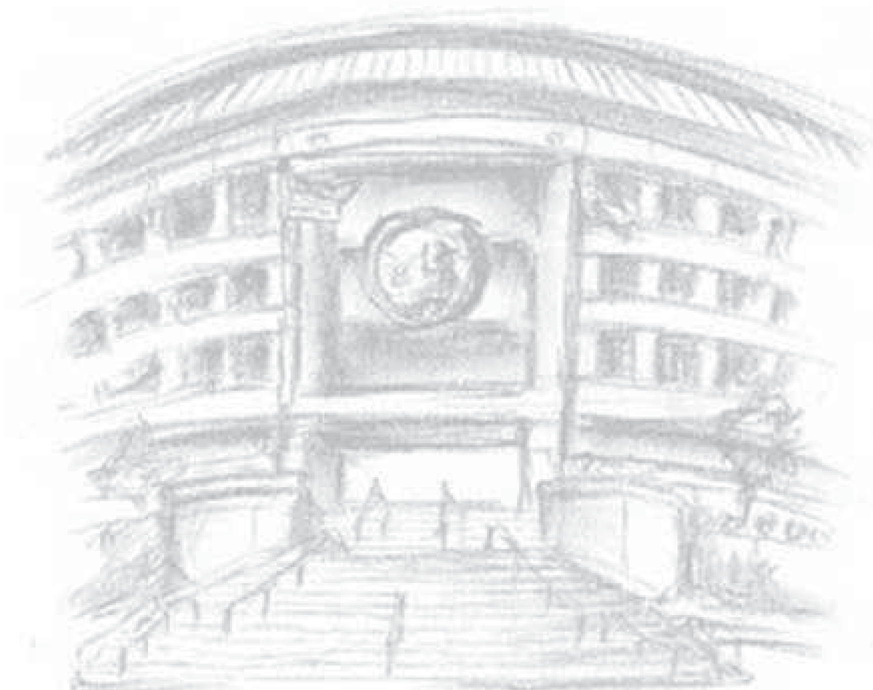
415-703-1606

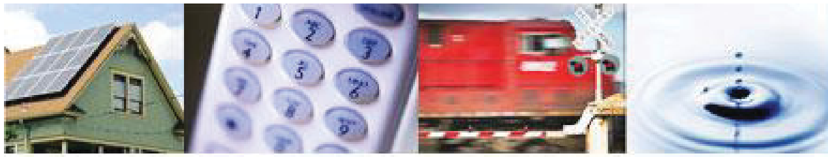


www.cpuc.ca.gov

California Independent System Operator Regionalization

Colin Rizzo, Esq. | Energy Division

Workshop: Communications for Optimized Water and Energy Management
October 20, 2016

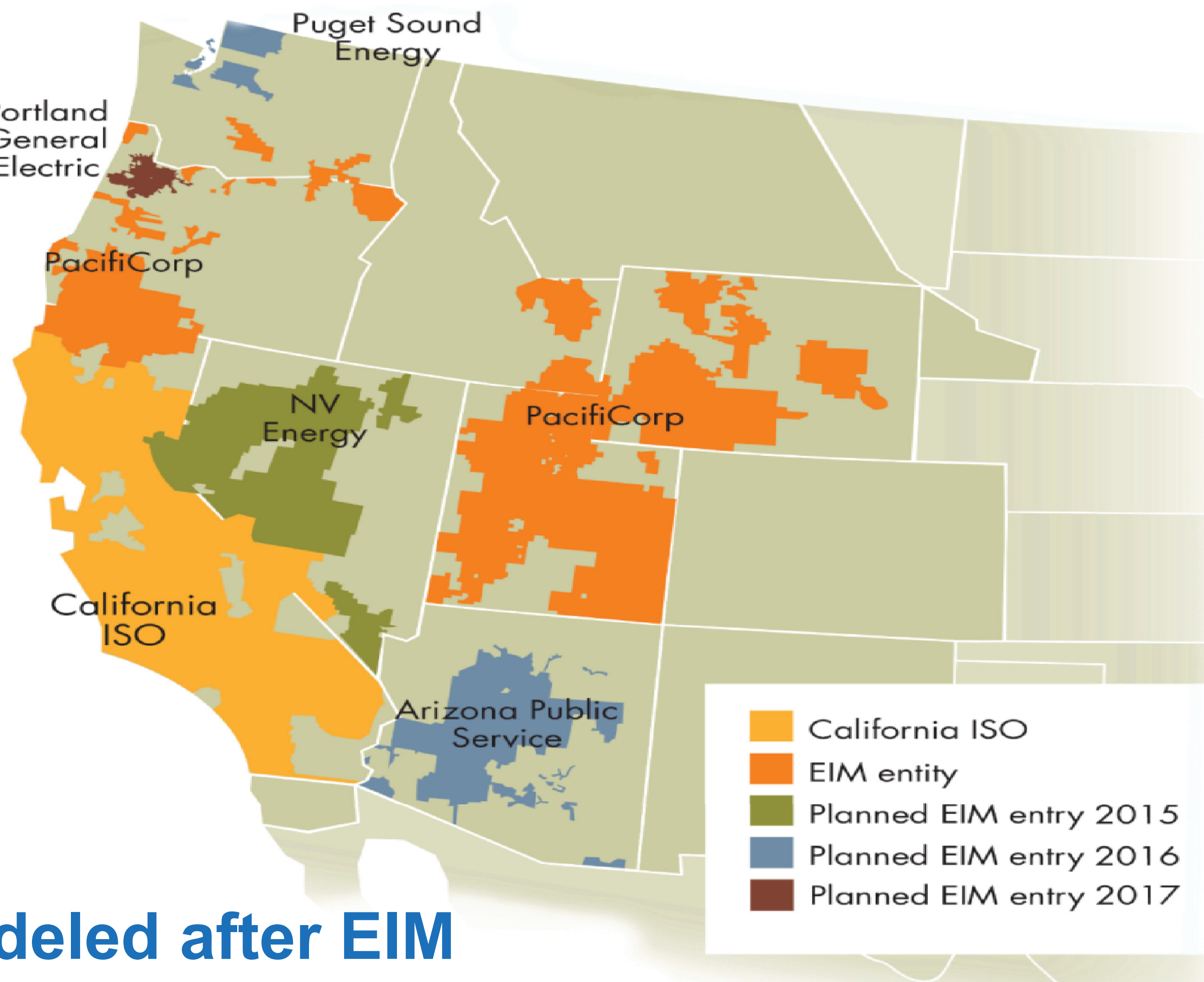


SB 350 Requirements

- SB 350 acknowledges need to modify current governance structure to allow transformation into a regional ISO.
  - Current ISO Board of Governors consists of 5 members who are appointed by the Governor of California.
  - Transition away from California-centric board necessary to satisfy other western states whose utilities could join expanded ISO.

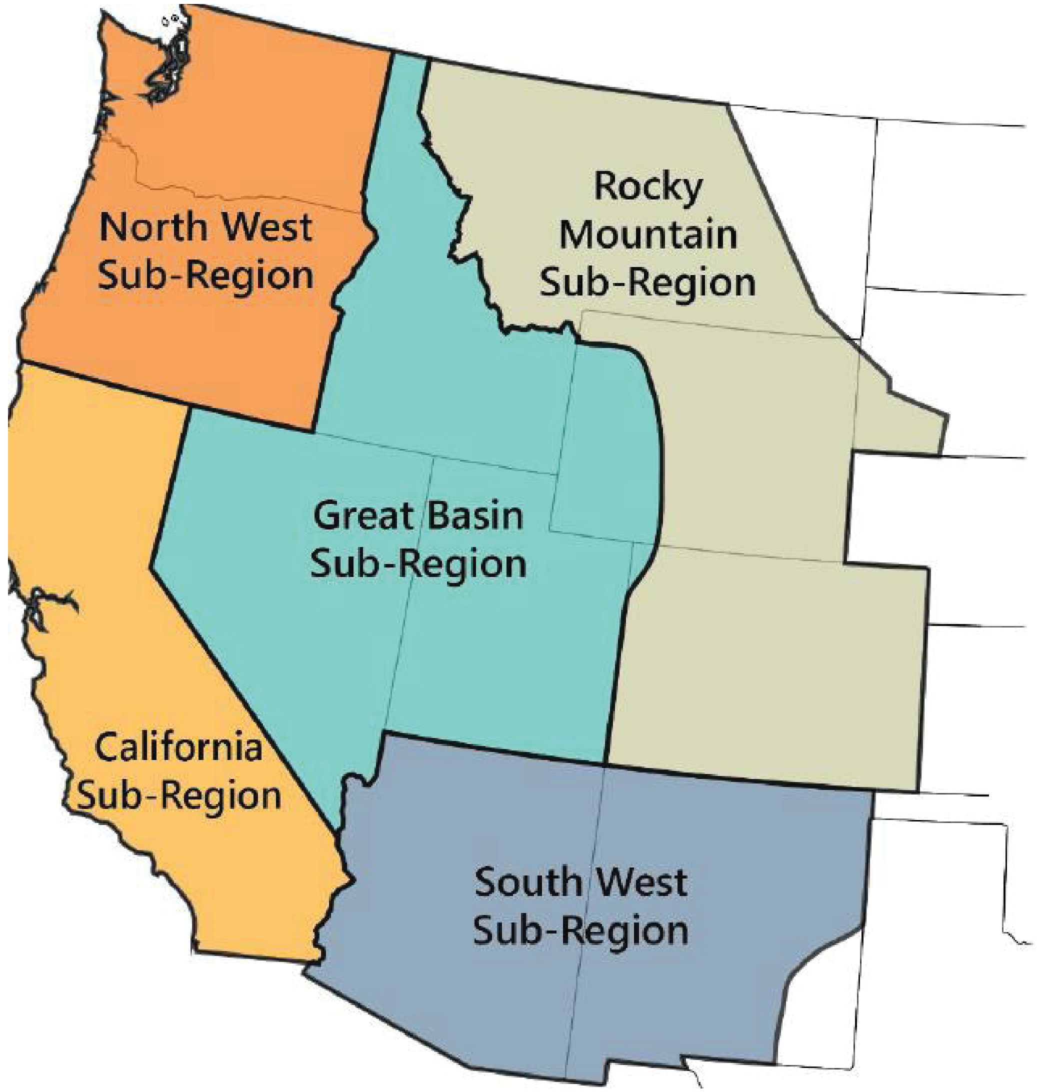
- SB 350 directs ISO to “prepare the governance modifications” and submit “revised bylaws or other corporate governance documents “ with proposed modifications.

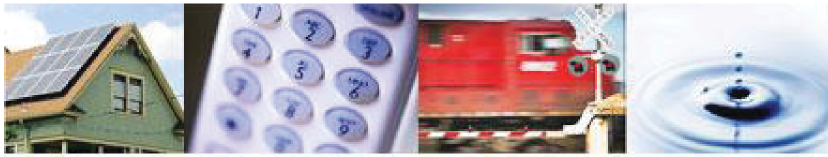
Regional ISO Participants



***modeled after EIM**

Western Regional Grid Operator's Region

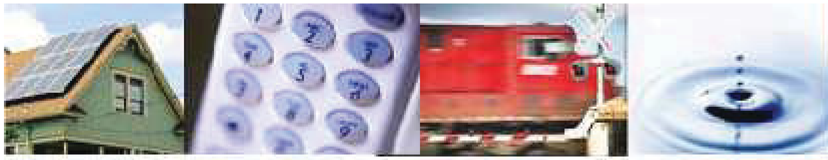




Issues and Challenges from Regionalization

- <u>Governance Structure:</u> Western States Committee (WSC) controls the western region.
- <u>Transmission and Interconnection:</u> regional proposal disproportionally balances costs and benefits among regional participants.
- <u>Resource Adequacy:</u> regional proposal attempts to usurp agency coordination.
- <u>CAISO Communication Requirements:</u> not incorporated into regional proposal.

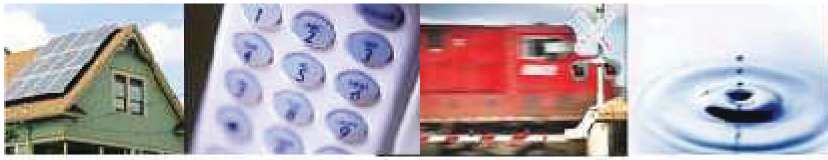
(END OF ATTACHMENT)



Smart Inverter WG Recommendations

Phase 1 Autonomous Functions	Phase 2 Communications	Phase 3 Advanced Functions

1. Anti-islanding
2. Voltage ride-through
3. Frequency ride-through
4. Vol/var control
5. Default and emergency ramp rates
6. Fixed power factor
7. "Soft-start" methods
	• Three pathways:
	  • IOU – DER
	  • IOU – DERMS
	  • IOU – retail aggregator
	• Default protocol: IEEE 2030.5 (aka SEP 2.0)
		• Monitor key DER data
		• DER cease to energize/return to service request
		• Limit maximum real power mode
		• Set real power mode
		• Frequency-Watt emergency mode
		• Volt-watt mode
		• Dynamic reactive current support mode
		• Scheduling power values and modes



Smart Inverter WG Recommendations

Phase 1 Autonomous Functions	Phase 2 Communications	Phase 3 Advanced Functions
• Commission adopted in December 2014 • UL testing/certification completed last month • Requirements go live **September 8, 2017**	• Recommendations completed February 2015 • D.16-06-052 requires utilities to file revisions to Rule 21 *OR* file status report and work plan by **December 20, 2016**	• Recommendations completed March 2016 • D.16-06-052 requires utilities to file revisions to Rule 21 *OR* file status report and work plan by **December 20, 2016**

(END OF ATTACHMENT)